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ABSTRACT

This collection of papers focuses on numeracy education for adults. In a paper entitled "Functional Numeracy," Terry Riley questions the underlying assumptions of functional numeracy and suggests that the term has often been distorted and oversimplified. Margeret Moss, in her paper "The Language of Numeracy," stresses that numeracy has a language of its own: the code of mathematics that everyone learns in childhood. John Traxler's paper, "Computers in Basic Education," discusses the importance of recognizing computer technology's role as a teaching tool and as a key factor in our social, economic, and political future. In his paper entitled "Numeracy, Publicity, and Outreach," Ken Marks examines adults' attitudes toward returning to school and their general feeling of inadequacy with regard to mathematics. John Willis' paper "Who Are These People with Numeracy Problems?" deals with the reasons why so many adults seem to have difficulties with numeracy. In a paper entitled "Numeracy as a Communication and Coping Skill," Ros Penny states that although mechanical skills are necessary, they need to be used in conjunction with an understanding of basic mathematical concepts. (MN)

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VIEWPOINTS

A SERIES OF OCCASIONAL PAPERS ON BASIC EDUCATION

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ISSUE No. 1

NUMERACY

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FUNCTIONAL NUMERACY · Terry Riley

THE LANGUAGE OF NUMERACY · Margaret Moss

COMPUTERS IN BASIC EDUCATION · John Traxler

NUMERACY, PUBLICITY & OUTREACH · Ken Marks

WHO ARE THESE PEOPLE WITH NUMERACY PROBLEMS? · John Willis

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ALBSU
Adult Literacy & Basic Skills Unit

VIEWPOINTS

A SERIES OF OCCASIONAL PAPERS ON BASIC EDUCATION

Introduction

This first of a series of occasional papers on specific topics in basic education, focusses on Numeracy work with adults. In the first article, Terry Riley questions the underlying assumptions of functional numeracy and suggests that the term has often been distorted and over simplified. Margaret Moss points out that numeracy has a language of its own, whilst John Traxler stresses the need to recognise that computer technology is both a powerful teaching tool as well as a key factor in determining our social, economic and political future. Ken Marks in an article entitled 'Numeracy, Publicity and Outreach' examines the attitudes of adults towards returning to study and their general feeling of inadequacy regarding mathematics. John Willis speculates on why so many adults seem to have difficulties with numeracy and Ross Penny points out that although mechanical skills are necessary they need to be used with an understanding of basic mathematical concepts.

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Functional Numeracy

TERRY RILEY

Terry Riley is the lecturer responsible for Adult Basic and Continuing Education in Nottinghamshire. He has a particular interest in Numeracy, which began in Nottingham in 1975 and was the author of the 'Make It Count' Yorkshire TV and NEC Tutor's Pack.

The received orthodoxy in numeracy teaching is that wherever possible the work should be of a functional nature. Much has been written to the effect that numeracy must be practical - that it is only of value when it relates to the real world. I accept this orthodoxy. However, like all beliefs it tends to become distorted and over-simplified and there is a need from time to time to question the underlying assumptions.

It is true that for most people mathematics is not an end in itself: it is a tool with which we solve problems. The functional approach to numeracy, though, goes further in that it advocates that the *teaching* of basic maths needs to be related to everyday life. At worst this results in the wholesale use of worksheets on "real topics" which may or may not interest or concern the students. Thus instead of the traditional textbooks with examples concerning the volume of baths with taps running, or the speed of trains, "leaving Edinburgh at . . . " we have the inevitable worksheets on budgeting for a "caravan holiday in Wales", "how to read a gas meter" and other topics which are currently in vogue.

THE RELEVANCE OF WORK FOR THE STUDENT

I am not saying that these may not be fruitful areas of work but they can *only* be so if they are relevant to the student at any given time. To present a student with a worksheet on costing a holiday in Wales when in fact he or she is going to Majorca, or is unemployed and going nowhere is a travesty of the functional approach. It is no better than using a standard school testbook. To be truely functional the work must derive from the student. This is both time consuming and difficult to plan and so it is tempting to use material already at hand. I think all of us who have ever been involved in the production of functional numeracy worksheets and packs for publication must be aware of the central dilemma, that even with disclaimers that they are only examples of the type of work that can be developed with a student, that nevertheless they are frequently used indiscriminately. By definition it is impossible to produce functional materials for publication, only *examples* of what can be used by individuals or particular groups.

At best the functional approach is one which proposed that the student acquires and develops mathematical skills within the context of the real problems that he or she faces. Most of us would agree that this is a laudable, if somewhat demanding, teaching strategy; but is this the be all and end all? Surely not? Experience shows us that many students (if not the majority) seek numeracy tuition for reasons other than the solution of "everyday" problems. There are few indeed who make statements like "I want to check my electricity bill" or "I need to calculate my petrol consumption" but very many who feel a vague uneasiness with numbers and feel they have "missed out" on part of their education. Those who do come with a specific need rarely express it in terms of a functional-type difficulty; or rather, it is functional in a different sense: they need to pass an entrance test for either employment or training. Whether these tests are well designed or not is a separate issue and not relevant to this discussion. What *is* important is that such students require numeracy tuition for reasons other than assistance with specific everyday problems. This is not to say that those who have a general reason or those who wish to pass a test may not also have a subsidiary aim of being able to cope more adequately with everyday mathematical problems nor that they will not benefit from a functional component in their course. It is simply to say that an exclusively functional approach is not always the most appropriate.

REASONS FOR SEEKING TUITION

It is extremely difficult to assess why students seek tuition, and notoriously easy to make generalisations. The best assessment is perhaps from students themselves. No doubt along with many other schemes and institutions the Adult Literacy Centre in Nottingham has kept records of the self-expressed motivations of numeracy students at the point at which they enter into tuition. Table 1 shows their distribution into motivational categories. This is of

SELF-PERCEIVED MOTIVATION OF NUMERACY STUDENTS

	Male	*Female*
Specific "functional" e.g.: work out benefits	0	2
Specific training/ Employment tests	15	11
Non-specific employment reasons	13	7
Family, i.e. to help children	1	2
General, i.e. status reasons and a feeling of having "missed out"	23	17
Educational, i.e. to be able to cope better with other courses of study	2	3
Total	54	42

course a very small scale enquiry and reflects the expressed needs of those wishing to join a course of study. It is arguable that those attending a drop-in Numeracy Centre would express very different preferances and would need assistance with a particular problem or problems. Nevertheless, within the constraints of this sample the evidence is overwhelming that students, *at their point of entry* do not perceive their primary mathematical needs as ones relating to every day problems.

DIFFICULTIES OF DEFINITION

The difficulty is one of definition. It could be argued that I am using "functional" in a very restricted sense. I am excluding anyone who comes, for instance, for job reasons - either to gain employment or promotion - from the category of functional motivation. Yet, on one reading that would seem to be a group of people who pre-eminently have functional needs. However, their needs are very different in kind from someone who wants specific help with say a tax form. The difference is highlighted when considering the appropriate learning content for both groups. The "employment" group wish to improve their mathematical skills in general and indeed where an examination or test is the end result they want to be able to perform some calculations irrespective of the likelihood of their ever being required to do so outside of the examination room. The "functional" group on the other hand are primarily concerned with solving immediate practical problems involving mathematical operations. Similarly another smaller group, those wishing to help their children with their school work, may superficially be regarded as being highly functionally motivated. Once again though their need is at one remove. It is not simply a matter of providing the solution to a particular problem set by their child's schoolteacher (or at least it shouldn't be!) but of providing a general course in Basic Maths that will equip them to understand and explain a whole range of mathematical problems.

The largest group in this particular survey are those who have general reasons for wishing to attend numeracy courses. One would expect many of these to have less precisely defined functional needs - not so much wanting help, say, with one particular form but with calculations on forms in general, not so much with checking a particular bill as with all bills. However, this doesn't seem to be the case. This category simply wanted to improve their maths for reasons of personal satisfaction and self-image. They felt that for a variety of reasons they had failed to learn while at school. They recognised Maths as being important and therefore something which they should study. The self-perceived reasons for failure at school were not surprising - "I'm thick when it comes to Maths", - "they didn't teach me", "I never got the hang of it" and so on.

Much of the functional argument for numeracy teaching is a parallel of that developed over recent years in the teaching of literacy. No-one would doubt the need for relevancy in the teaching of numeracy. However, the two subjects are very different. Mathematics, at least at an elementary level, is a hightly structured language-game and has an innate progression of concepts and operations which are logically dissimilar to the acquisition of spoken and written languages. To give an example, it would be impossible for someone using Arabic notation to successfully complete the following 4 1 3 6 without having a concept of place-value whereas it is quite normal for someone to correctly read a sentence such as "He bought the newspaper" and have no phonic ability.

$$\begin{array}{r} 4\,1\,3\,6 \\ -\,3\,3\,7\,9 \\ \hline \end{array}$$

FUNCTIONAL NUMERACY

"Functional numeracy" as a term is used in two different ways. The first relates to basic maths as applied to the solving of specific problems in everyday life. The second, and looser sense, is of any basic mathematics study which is perceived as having relevance to the student. This latter usage is so nebulous and all-embracing that it adds little if anything to the debate. In this sense, for instance, anyone wishing to follow a course in elementary trigonometry in order to pass an employment test is studying functional numeracy. One wonders on this usage, who studying numeracy is not engaging in functional numeracy!

The term does serve a useful purpose if restricted to its narrower sense. However, it may be that most students who seek numeracy tuition do not in fact immediately perceive their needs as functional but simply wish to acquire basic mathematical skills for a variety of reasons. The implications of this are quite far-reaching for teaching styles and materials. The new orthodoxy insists on the acquisition of skills within the context of everyday problems and its favoured teaching material is the ubiquitous worksheet. I am not suggesting we take back on board the traditional orthodoxy uncritically and return to the lamentable old text books with their columns of numerical calculations and pages of sterile "problems". Nevertheless, basic mathematics has an internal logic unique to itself and a progression of concepts and operations which need to be acquired. We need to adopt a balanced approach: one in which mathematical rules are understood and practised, and, *where appropriate*, used in situations deemed to be relevant to the student by the student.

BROADENING HORIZONS

It may be argued that part of our function as educators is to broaden horizons and extend student expectations. Certainly most of us will be only too familiar with students who regard Maths as the arithmetic they did at school. They are dismayed if not "working" at sums, hoping to get ticks, instead of "wasting their time" on graphs, or even worse, "cheating" by using calculators. Part of the role of the numeracy tutor is to introduce subject areas such as graphs and the interpretation of tabular information especially since the media employ them increasingly and without a familiarity with them it would be difficult to understand the world about us. Similarly, in an age of increasing technological sophistication, the basic education tutor has a responsibility to introduce his students to the use of calculators and, where possible, computers. This process of modifying student expectations of what Maths entails, if to be done effectively, needs to be done gradually and needs to be done with full student co-operation. Many basic education students come on a voluntary basis and have the power to vote with their feet. If they arrive expecting and wishing to improve their basic arithmetical skills in general and are suddenly presented with a barrage of tax forms, recipes, advertisements for discounts, etc., etc., we should not be too surprised if they never return. Not only will the student then have missed his or her chance to acquire the basic skills but the tutor will also have missed the opportunity to broaden the curriculum and introduce the student to much of the excitement which is mathematics.

We should never forget that group of students who gain real pleasure from Maths and numbers. Admittedly, the group may be small in size but it is not insignificant by any means. We need only look at the popularity of number and spatial puzzles, not practical problems to help with coping with everyday life but people who upon completion of a basic numeracy course, enrol for "O" level maths, not for job reasons but simply because at last they have got the "hang of it" and want to pursue the subject for its own sake.

CONCLUSION

To sum up. Mathematics is a logically rule-dominated language. It is essentially a tool but not exclusively so: it has its own beauty as all "languages" have. The majority of adult students may neither regard it as a direct means of solving problems nor see it as an aesthetic or intellectual pursuit but rather as a recognised area of the curriculum with which they feel out of touch.

A thorough-going functional approach although appropriate to literacy may not be the most appropriate teaching methodology for all numeracy students. The indications are that the majority of students want and need tuition which is systematic and adheres to the logic of the subject, but that does not deny the importance of relevant teaching materials.

As with other aspects of Adult Basic Education, numeracy tuition needs to be adaptable and the tutor to be willing to adopt subject content areas and teaching strategies appropriate to his or her students. Perhaps a discipline as young a A.B.E. has no need of orthodoxies but, instead, still needs to be questioning.

The Language of Numeracy

MARGARET MOSS

Margaret Moss is the Development Officer and Organiser based at Reading Adult College and initiates new projects in Adult Education. Prior to this she was the Adult Numeracy Organiser for Reading and continues to teach a numeracy group.

Adult education is a distinctly different form of education in the English educational system and is characterised by its voluntary nature, its breadth of curriculum and its entrepreneurial style. It is quite unlike traditional schooling or vocational further education. Amongst its goals are autonomy (the students right to choose the classes he will attend), individuality (develop in a unique way and select from a broad curriculum) and equality (in relationship with the tutor so that both develop through the process of learning together). That small part of Adult Education called Numeracy epitomises all of this. An individual who has identified a need or desire to deal with numbers more competently, speedily and comfortably will then choose whether or not to ask for help. In asking he will state these needs and wants and will contribute with the tutor and the other students, to the learning which takes place.

THE STUDENT'S EXPECTATIONS

The student will learn to do whatever he came to do; he will, no doubt, also, learn a lot of things he did not come specifically to learn. He will enable others to learn from him by sharing his knowledge, interests and expertise in the social interchange occuring in the group.

A numeracy student always brings an expectation of "maths" and "maths class". Some are suspicious when they find that what is going on does not fit that expectation. Some are reluctant to give up that expectation. Some are relieved to find that it is all different and that they can actually enjoy dealing with numbers. One of the last things a student is aware he brings to a numeracy group is a problem with literacy. Of course if the student has a literacy problem, it comes along too but the student has the numeracy problem as the priority at that particular time.

REASONS FOR SEEKING NUMERACY TUITION

Why do students come to Numeracy? The usual replies from anyone involved would include "hopeless in maths", "need to pass a job test", etc, etc.

They never identify the problem as being a difficulty in comprehension. Yet this is very often the case.

Mathematics uses a code, a code which to one who is familiar with it is a simple code. The concepts behind the coded system are to those who understand them also simple. The study of mathematics becomes difficult when the code or the concept ceases to be comprehensable. The code is made up of symbols - numbers and operations e.g. 23, +, —, ÷, =, %, ¼.

Many of the students are able to calculate efficiently but prefer not to do so with paper and pen nor to have anyone see their written calculations, as exemplified by rough work or only answers given.

The code of mathematics is difficult and they do not use it in the "correct way". If they have not learned the code, or are unfamiliar with it, or don't understand it, then their level of numeracy is affected. They may in fact have worked very hard to make up a code of their own.

THE MATHEMATICAL CODE

This code of mathematics is in fact a language which everyone speaks from childhood - intertwined inseparably with the English language. Provided the concepts are understood the language is accepted, understood and used. A child asked how many buses at the stop can usually reply as accurately as if asked what colour the buses are. Of necessity money is used for various transactions, coins and notes identified, change checked, budgets calculated, savings and economies made, all using (the familiar?) language. Experience in everyday life extends the mathematical language in areas of individual interest, e.g. betting odds are calculated, winnings predicted, the setting up of a hi-fi system calculated, the digital display of a video machine is mastered and used efficiently. And so too it is used and extended in the work situation: sand, cement and water are mixed to form mortar; a machine is set; sparking plugs measured and adjusted; fencing erected; furniture loaded into a van.

An awareness of language whilst teaching numeracy is vital and the language of numeracy should be at the forefront when teaching number skills.

The number skills which are inevitably present in numeracy work are not primarily what numeracy is about (but others have defined numeracy in this collection of papers so I do not intend to do so here!). Numeracy is not "basic maths" nor is it "everyday maths" - it involves some or both of these but not only these. (As soon as "maths" is mentioned the expectations raised are not necessarily appropriate to numeracy).

An attention to language and to numeracy (instead of maths) when a student looks for help in taking away (a number skill) means that all the language of subtraction cannot be presented immediately. We cannot present all the possible combinations of the code and its language when a student merely wishes to share the cost of a bottle of Christmas spirit with his two flat mates. And nor should we! The student and his language, which he brings with him should provide the answer.

NUMERACY AS A PART OF EVERYDAY LIFE

Numeracy work is but part of a greater whole. It is part of every individual's existence, part of his daily routine, part of his daily requirements, one of his rights. To try to separate it out from all of this is to make it mathematics - a

subject for study for its own sake. Each individual determines, in some way or other, his own need for and level of numeracy just as of everything else. Some external demand may cause changes in an individual's life - demands from work or home may cause changes in financial arrangements, in housing, in transport or in levels of numeracy and literacy. This is true throughout society and Adult Basic Education becomes involved when the changes caused in literacy or numeracy require additional help. Work in this field tends to be either in literacy or in numeracy. Yet any tutor working in literacy will acknowledge that calculations also occur; timetables, money, cooking, mapreading, all these may be part of literacy work. Similarly any numeracy tutor will acknowledge that reading and writing form a portion of the work.

The two go hand in hand, inseparable, interlinked, dependent upon each other. Basic Education tutors should provide a variety of opportunities where students can experience, learn, practise, reject, demand literacy and numeracy skills in context. It is likely that some students already develop their skills in this sort of way. An evening centre head spoke rather unhappily of an acquaintance, who needed help with numeracy saying:

> "When I did persuade him to come along to the centre for a class, he entrolled for beekeeping! I don't think he'll ever enrol for numeracy now."

Perhaps with and through the subject the student learned all the numeracy he needed.

In some cases there is printed information which needs consideration, written conclusions required (and perhaps some record of the calculation made). It is at this point that "problems" can occur. The reading ability of the individual needs consideration. The language used may obscure the mathematical operation.

Working in a group a student's reading ability must be considered, and work must be described in ways that the student understands. It is imperative to use the language of the world in preferance to the language of the mathematicians - a builder doesn't add bricks, he builds a wall; a carpenter doesn't subtract a length, he cuts it off; a mother doesn't fractionalise vegetables, she shares them out; a child doesn't eat one eighth of a cake, it has a piece.

Because the student has initially described his situation verbally, the written form can then bear as close a resemblance to real life as possible if the language is kept constant. This should facilitate comprehension and perhaps provide the clues as to how to "solve the problem".

It is through the "need" that the student came and it is through the "need" that learning should occur. So the written work can and should be used *mostly* if that is how the student meets the situation.

WORDS AND NUMBERS

The transference of the written word into the mathematical code is another point at which confusion may occur. After all we always read from left to right, and from top to bottom, and always write from left to right, and from top to bottom. Great emphasis is given to this very important starting point and rightly so. According to the starting point and the direction in which it is read, one mathematical code may be translated into several verbal phrases.

e.g.

A simple sum such as:

13 − 2 = 11 can be read as:

thirteen take away two is eleven
thirteen minus two equals eleven
two from thirteen is eleven
eleven is two from thirteen
eleven is two less than thirteen
eleven is thirteen minus two
if you take two from thirteen you've got eleven left.

In a simple example such as this there are many starting points and directions. It is quire difficult to write the correct code if the starting point is "I grew 18 lbs of beans this year, I had paid £2.40 for the bean poles and £1.20 for the plants. Did I save very much by growing them when they cost 35p a pound in the shop."?

As in any other "foreign" language, there may be several meanings, several phrases suitable for use when translating a particular symbol. Great skill and understanding is necessary to choose the most appropriate. Those who understand it and appreciate it take it further and further, revelling in its beauty - forgetting that is may not be the same for everyone.

Imagine, if you have learned to recognise and identify the notes on the stave in the treble clef,

viz.



and, can singe moderately in tune what your reaction would be to this:



if you were asked to sing it now. Such is the reaction, all too often, to the maths code - but you don't have to use it in all its complexity to be numerate just as you don't need to be able to read music at concert level if you only sing in the bath!

So what happens when the code is actually approached from the other direction? Is it possible to teach someone to sing your favourite song well enough without the written music, even if you yourself are a musician? So too you can teach calculations without the whole notation being known or understood even if you yourself are a mathematician - it is the concept rather than the code which is then being thought about and worked on.

WRITING DOWN CALCULATIONS

But when the need *is* to write down the calculation, then a careful approach is required. Use the language of the

student initially, appreciating the colloquialisms and using them; amend the language, both verbal and coded developing it wherever and whenever it is appropriate to do so. The student may accept or reject the development at any time or may himself demand a wider choice of language.

EXTENDING THE CODE

As the pattern of language develops and is extended so, too, is the code. The level of difficulty encountered increases and the coding level is raised alongside. Sometimes a student may have developed an individual code as a result of coping on his own without reference to other users. The mathematical code needs to be standardised in order to be understood by anyone and everyone. So an individually developed form may or may not require to be "corrected"; it depends on what it's for and when it is used. Those we use and pass on to each other (i.e. teach) need to be recognised and understood by others. An individually developed code may result from a half remembered one learned earlier e.g. a student may write 12 ÷ 72 and mean how many 12's in 72? If this form is likely to be shown to others then it is useful to explain the language and meaning which others will use when seeing it written thus. Because the student formulates the problem in this way it does not mean that he is not able to read correctly the code as used by others.

The influence that our familiarity with the code and language has should be carefully monitored too. In presenting suitable problems to students we tutors feel that the words take a long time to write and slip into using the code (it says the same thing after all doesn't it?). We allow the language and the problems to develop perhaps to alleviate the repetition which we tutors find slightly boring. Our student receives this and is faced with a more complex problem than he can comfortably handle and with language he does not fully comprehend. However, as far as he knows, we tutors obviously expect him to handle the problem and to understand the language for we have presented it to him - and we know what we're doing, don't we? How much better to present work at his own level of difficulty and his own level of language which allows him room and time for thought. For this then provides him with an opportunity to express opinions, facts, and knowledge of other things.

MATHEMATICS AND ENGLISH AS A SECOND LANGUAGE (ESL)

Up to this point all that has been said is based on the assumption that English is the student's first language. The inter-relationship of maths and English is permanent - yet maths is a second language which can develop and grow at a separate rate. The growth of an individual's numeracy is dependent on his language and communication. For those students whose first language is not English how much greater may that communication problem be! The Asian student may calculate perfectly but be unable to verbalise the processes in English; he may require help with all the English words and phrases which go with the code he already knows and understands. The European student may perform the calculations, using more or less accurate English, in a completely foreign manner e.g. 384 ÷ 62 Italian style:

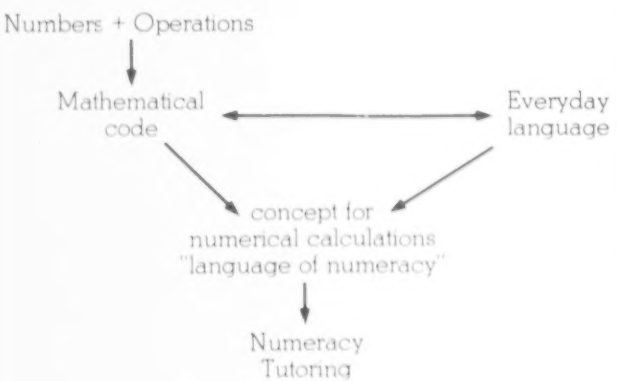
$$\overline{38'4} \quad \frac{62}{6}$$
$$12$$

There is a rich variety of language encountered whilst helping students develop their numeracy skills. Each person's comprehension of a concept may be individual and their way of describing it will be in their own personal way.

However, there are some ESL students whose use of English and of the maths code is limited, presenting tutors with another challenge. For these students, difficulties are acknowledged as partially effected by language problems. Great care is then taken with choice of words, with symbols, with explanations. What a pointer this might be to our thinking about the other students. It may be that the numerical inability of the other students is also caused by the language. Any student's feeling of incompetance with numbers may be the result of his inability or limited use of the language. Society expects a certain facility with the language of maths and demands certain uses of it (for job tests, entry requirements and the like).

An initial approach to a student's difficulties along the lines of that used with ESL students may be equally appropriate. Perhaps it is the use of the code and the use of inappropriate language which is the cause of the difficulties. Perhaps numeracy problems are often a result of these being developed at different rates.

Historically, literacy provision was established and has grown through numeracy and ESL work to Basic Education provision. As a result the elements are separated, offered separately and envisaged in separate compartments. Links between them are being established and where appropriate, provision of all the elements is available at the same time and place. Certainly there is much to be said for co-operation between tutors. Each can learn from the others' approaches. We are, it seems, all concerned with the same fundamental - a language.



CONCLUSION

The everyday language combined with the code provide the basis for numerical calculations in life and will have considerable influence in numeracy tutoring. Our tutoring is usually based on *our* understanding of the code and its associated language in response to a demand from a student. If we primarily consider the student's understanding of the language of numeracy, and concentrate on that rather than the code, will our approach and methods change? Learning is something the student does on his own, with our help. For him to learn, he must be able to develop what he already knows, he must start "from where he's at". We must help him to do that and our approach and methods must reflect his numeracy before they reflect our mathematical knowledge.

Computers in Basic Education

JOHN TRAXLER

John Traxler is the Course Organiser for Computers in Basic Education which is a Friends' Centre Project in Brighton. He has worked in Basic Education for six years and before this was engaged in research in computing at University College, London.

The Friends Centre is a voluntary organisation based in central Brighton, with a wide programme of adult education and a history of innovation and development of basic education for adults.

In April 1983, the Centre started a major two-year project to investigate the usefulness of microcomputers in numeracy teaching and vocational preparation. The Centre is collaborating with the Department of Computing and Cybernetics at Brighton Polytechnic and the project is funded by the Social Fund of the EEC.

The first part of this paper will describe the project and its background and the second part will examine some of the broader implications for basic education of the spread of microcomputers and the "new" technology.

THE FRIENDS' CENTRE

The Centre's work in ABE goes back over seven years and now consists of a number of different sorts of provision. In this respect it is probably reasonably representative of the national picture. The EEC project grows out of this history and draws on many of the ideas in our work.

The largest form of provision is the TOPS Preparatory Course. It is the only such course to be run by a voluntary organisation and is also a comparatively old and well-established course. Briefly, it is a full-time (9 am-5 pm, Monday to Friday) 12-18 week course of literacy and numeracy for people who are unemployed. Its objectives are economic, namely increased employability, rather than educational and the MSC provide assistance with counselling and selection. The students, known as "trainees", receive the standard TOPS training allowances, with, in some cases, a contribution towards travelling costs. The majority of students are referred by Jobcentres in the Brighton and Hove conurbation and a significant number go on to Skillcentres.

Over the years an increasing number of women have come into the course but the full-time nature of the course and the absence of a suitable creche has obviously militated against even more women, especially single-parents, applying. Also as unempolyment has worsened (it is slightly above the south-east average - there are over 11,000 unemployed in the conurbation of whom about half are defined as "long-term") there have been occasional examples of resistance to the idea of women going on to train for anything but traditional women's jobs. Partly this has been because, once they are trained there is still employer resistance and partly because training interviewers need to feel that would-be trainees have suitable experience and interests to build on. These are areas that we hope to tackle in the new project.

There has also been a steady increase in the number of second-language students coming onto the preparatory course. This has been due to word-of-mouth contact within particular communities, sometimes Egyptian, sometimes Gujerati and so on, and also due to a growing awareness amongst Jobcentre training officers that the course has something to offer this disparate group of people. Many of them are highly qualified and experienced in their countries of origin and only need to increase their verbal fluency and grammatical accuracy and acquire the appropriate technical vocabulary in order to translate their skills into a new context. We have had electrical engineers, accountants, auto mechanics and refrigeration engineers. Many need more time than the TOPS course allows and need fairly individualised and wide-ranging teaching to bring out their technical backgrounds. We hope that the new project will work towards a more appropriate response to these kinds of needs.

TRADE TRAINING AT A SKILLS CENTRE

To look now at a different constituency, there is a large proportion of our preparatory course students whose ambition is trade-training at a Skillcentre but who, at the moment, don't have the opportunity to realise their full potential for a variety of reasons. One is course length: Over the years both the average and the maximum stay on the preparatory course have been progressivly reduced. Currently, students are accepted for 12 weeks and this can be extended by a further six weeks. This is frequently too short since entry to training is decided by tests and interviews. As unemployment has increased, there has been more pressure on training establishments, but not a corresponding expansion in training opportunities so what were easy but inappropriate entry tests seem now to be used to eliminate a larger and larger proportion of candidates. This has forced people wanting a Skillcentre place to concentrate on arithmetic manipulation and grammatical precision at the expense of a broader basic education and skill, in many cases, forced them to forego their preferred course for an easier one for which they have much less enthusiasm. In addition, any of the courses in the south-east which are still taking people probably involve a wait of up to a year before the course starts. This is wasted time, desperately needed for preparation, when many people become depressed at the sensation of their educational progress gradually slipping away. We hope that the new project will allow some of these people the chance to continue the educational preparation for training. We recognise that the 30 or so places we can provide in the new project will make only a small difference to these problems and are certainly no substitute for an adequate level of resources in local government sponsored vocational training. Nor is the project an attempt to shift the burden of educational responsibility from the local authority but to show both a new form of provision at the interface between the two.

'STUDY TO WORK' COURSE

Because the new project involves the provision of a part-time course, we have drawn extensively on the experience of the part-time "Study to Work" course that runs alongside the TOPS preparatory course. For its first two years, this was an ALBSU development project. Now it is funded by the local MSC region - perhaps it hints at how they see their future involvement in ABE.

Students attend for up to four half-days per week and thanks to the "21 hour" rule are still eligible for unemployment or supplementary benefits. This relieves the MSC of the responsibility to pay training allowances, but the voluntary nature of the course makes a substantial distinction between Study to Work and the Preparatory course. The course is intended solely for people who are unemployed long-term, over six months, but this criterion, in the present economic climate, has yet to prove a major stumbling block to recruitment.

For many people whose initial education was unhappy or is long forgotten, a part-time course is a useful way of learning the pattern of study in a relaxed atmosphere and many subsequently move successfully onto the TOPS course. Unfortunately part-time students have to find bus fares out of their own pockets - there is no fee for the course itself - and whilst travel costs within Brighton are expensive, anyone from further afield finds the costs prohibitive. Travel subsidy for TOPS students has also become increasingly inadequate and in a county with only minimal local authority ABE provision for rural students this is doubly unfortunate. We aim to provide some form of travel subsidy in the new project.

NEW HORIZONS

Another form of provision that has been a continued source of encouragement has been "New Horizons". We have attempted to incorporate the experience of these return-to-study, post-basic literacy courses in our new work. New Horizons started to provide an educationally-oriented (rather than vocationally-oriented) follow-up to basic literacy. ALU funded two substantial parallel part-time courses (day and evening) for two years and, in the absence of local authority support, they have survived in a reduced form with generous assistance from the Croft Trust and the WEA. The original model ran two days and two evenings a week, with a creche in the day-time. People attended for up to a year and the creche meant a high proportion of those who attended the day-time course were mothers. Recruitment was from both the literacy scheme - people ready to move on - and from elsewhere. Aside from the obvious importance of the creche, relevant aspects of the course were the science elements of the course and the development of materials.

The courses were aimed at people with a reasonable technical reading ability who would find difficulty tackling an entire book. This meant that much of the success of the teaching hinged on the sensitivity and interest of home-grown materials. Topics in history and literature, for example, were tackled and proved that complex issues were accessible if well-presented. Looking at the "new technology" is a major challenge for the new project as not only are the issues complex and novel, but also scientific.

On New Horizons, in its original form, there were two science components,. one a "pure" science course and the other a science discussion group.

We have had the opportunity, subsequently to think over our experience of science in adult education, in for example, evidence to the Advisory Council, but the points that came out are worth summarising: Our science discussion group was an undoubted success because in dealing with a topical scientific issue (e.g. Three Mile Island) it capitalised on current popular and media attention. Newspapers and other public material could be incorporated into worksheets. Current awareness of the topics meant that the discussion had a validity outside New Horizons - it wasn't just some hermetic subject that tutors thought was good educational value. Because the sessions revolved around discussion they were seen from a number of perspectives that put science into personal, social, economic, political and technological contexts - but avoided "science by stealth".

In retrospect, it is hardly surprising that the "pure" science course was harder work. Unfortunately time militated against an approach that starts with the particulars and the practicalities and moves gradually to the generalities and forced a more brief theoretical exposition upon us. Students wanted to learn about physics and chemistry, without knowing what this might involve - they had no previous experience of sciences and did not know what they wanted to know, not having ever, as it were, read the "menu" of science before. We were conscious that we could not *do* science, only describe it and whereas schools had laboratories to add flesh to the concepts and years to rehearse them, we had neither. With only a year at the most (using one session a week), we were forced to talk more in terms of generalities and abstraction, the realms of the theoretical, rather than letting them grow out of an experience of the concrete, the particular and the practical.

A NEW COURSE IN MICROCOMPUTING

It will be illuminating to think through a new course, based on the science of computing and the technology of microcomputers, in the light of these contrasting experiences. In a world still dazed from Information Technology Year, finding the initial sparks of interest should prove no problem.

Apart from the ideas and needs that have sprung directly from our basic education work, the project has also been informed by one area of our "mainstream" adult education computer programming.

We have had external tutors, but most of our experience has accumulated since we bought our own machines. We bought two Commodore 4016s (known to the world as "Pets") about a year ago, the choice being dictated by subsidy rather than any strong preference in favour of these particular machines. For their price they have proved extremely good value, especially in the light of their proven robustness. In a building as public and theft prone as ours even their bulk is an advantage.

The aims in buying them were threefold: to meet the growing demand for computer programming and "appreciation" classes; to make exploratory moves in computer-assisted numeracy teaching and to see how heavy, expensive machinery fitted into the rhythm of a crowded, hurried centre.

INTEREST IN THE COURSE

Since the courses have been offered, there has been a strong and continuous interest and students have attended for a variety of reasons: several were ZX81 owners and spent a lot of the sessions relearning their

programming on a larger and possibly more normal machine; others were parents trying to anticipate their children's homework or children trying to anticipate their own; some were thinking of buying a machine for domestic, business or recreational purposes and some worked in offices where word processors were being introduced. No-one wanted to be a professional programmer. One class was run on a morning when there was a creche and all of the class were women. People's attitudes, as opposed to their interests, also varied enormously: some wanted to hear computers described and see programming done - essentially lectures and demonstrations - whereas most want to *do* programs - a workshop situation, in today's parlance.

Probably most people found learning programming a perplexing experience (they had, after all, no experience against which to judge its ease or difficulty) and this may be because it as such a mixture of facets. It resembles learning a language (self-evident perhaps, but not necessarily so because it is completely artificial) and so success depends on repetition and practice. It also resembles a game in that it seems to have completely arbitrary rules and constraints and it resembles learning maths or physical science in that computer languages are very structured and hierarchic in their organisation. Someone with an aptitude for one aspect does not necessarily have an aptitude for the others.

Possibly it goes without saying in adult education, but all the classes were highly motivated (and good fun), most people did "homework" and some regularly turned up an hour early to practise.

NUMERACY AND THE USE OF MICROCOMPUTERS

Turning now to numeracy teaching, our own experiences bear out the observations made in ALBSU's "Use of microcomputers in basic education". It is all too apparent that any centre introducing micros into basic education needs to pursue a conscious and comprehensive policy. Unfortunately, this won't grow out of thin air and so piecemeal experience (and mistakes) and common sense can be quite helpful.

On this basis we casually acquired some "educational" programs (the cost often means one had to be fairly casual) and used them casually with students, at times when there were more tutors than normal, just to see what students make of machines and vice versa. The usefulness of the programs has been extremely patchy. Looked at under a number of headings, one quickly sees why.

Presentation, content and teaching method are reasonable headings under which to judge a program. The first, presentation, involves looking at the program as a set of images on the screen: are they cluttered, are they legible, are they restful to the eye, is the animation necessary and sufficient, does the program have a clear introduction? The second set of questions revolves around content - what is the subject being taught, how well is it paced and graded, what does it assume (e.g. literacy level) and does it have adults' or children's examples and points of reference? Finally, the most crucial questions centre on the teaching methods and their success. Some programs are "user-friendly", others just patronising. Some offer a fuller explanation of the topic when a mistake is made, others suggest finding a teacher. Most programs do not come through this evaluation with flying colours.

THE COMPUTER PROJECT

To turn now, at last, to the project itself: it is essentially a practical research project to run a pair of part-time courses for basic education students who are interested in the educational preparation of vocational or trade training. The focus of the courses' content is numeracy, whilst computer-assisted learning is central to the method. All aspects of the project are monitored and a major responsibility is translating the results into a European context.

All students are drawn from a cross-section of basic education students with a special emphasis given to women and ethnic minorities. Some of the students on current Friends Centre courses have applied. The parallel courses are a day-time one with a creche and an evening one, with possible joint day schools and visits.

Students are able to claim supplemenatry benefits or unemployment benefit with assistance towards travel and meals, but with a course of 18 months duration we recognise that continued attendance will require a high level of motivation and a sense of continuous progress.

The content of the course is basic and post-basic numeracy, computer literacy and employment studies. The latter focuses on self-employment, job-sharing and co-operatives as options alongside conventional employment; health and safety at work and a study of the past, present and future of the new technology and its effects on the structure of the local economy. Computer literacy, for a lack of a more agreeable term, encompasses operating a micro, programming in BASIC and looking at computer applications in factories, offices and educational and training establishments. The aim is to give an understanding of the impact and implications of micro-processor-based technology. As much as possible the teaching is developed with computer-assisted packages as an integral component of the whole course. This meant having a variety of programs prepared before the course started and evolving others rapidly as needs developed and directions become clearer. The Polytechnic has made available substantial "main-frame" computer hours and their team, headed by Dr K.S. Gill, is using their extensive experience of learning packages that integrate visual, spoken and written ideas to design the course material. We obviously need to strike a balance, in both hardware and software, between material that can be used nationally with existing set ups (e.g. machines like PETS and in BASIC) and material that is inherently more innovative and represents the state-of-the-art (e.g. speech synthesisers, 16 bit machines, etc). We also aim to expose students to as wide a variety of machines as possible.

THE CRUCIAL IMPORTANCE OF TEAMWORK

Obviously our relationship with the technical team is crucial and we see one of the growth areas as the way basic education tutors have to learn what computers can do and how they can teach in order to give the programmers the best possible specifications to work from. By the same token, the programmers have to develop a sense of computer-assisted learning in an adult basic education context. Alongside this aspect of the team-work we have made provision for some of the technician reception and clerical work to be undertaken by an ex-basic education student trained by and working alongside Polytechnic staff. This gives people valuable experience and could lead to the sort of high-technology

co-operatives that have grown up under the aegis of the Notting Dale ITEC. Obviously this is a cherished dream rather than certainty and its realisation would depend on a very thorough examination of local industrial opportunities. Brighton is a long way from the "silicon valley" of Edgeware Road and co-operative working is only one possible avenue for the course's students. Nevertheless industrial co-operatives may be a way of creating employment and doing so in a way that meets people's family responsibilities more sensitively than being employed.

MICROCOMPUTERS AND CHANGES IN SOCIETY

At this stage much is still speculative. There has been a three month setting-up period and in the middle there will be an interim report whilst at the end we shall hold a national conference and exhibition. We hope throughout the project to make our work as accessible and useful as possible and would welcome the opportunity to discuss it.

The importance of the project rests on two assumptions: firstly, microcomputers *can* dramatically change the quality of basic education and secondly, micro-processors, microcomputers and information technology *will* radically change our society. The first assumption is pedagogic, but the second is social, economic and political.

Over the last five years, many authors and organisations have set themselves the task of mapping out this future and change has been so rapid we are in a position already to check some of the earlier predictions. In general, these preditions divide in to the technical and technological ones and the economic, social and political ones - the former marked by optimism and the latter by pessimism.

"THE MIGHTY MICRO"

A popular, readable and basically optimistic book centred around technical issues is "The Mighty Micro", written a couple of years ago by Christopher Evans and published posthumously. It provided a framework for predictions and sees a three phase future. The first phase, 1980-1982, will be "gadgets and gimmicks"; the second 1983-1990, will be "exponential growth" and the last, from 1991 to 2000 will be characterised by "ultra-intelligent machines". This last phase need concern us no further.

This framework depends on a certain level of global economic health and so the present world-wide recession has retarded developments. In any case, the longer-term predictions are inherently less precise.

Our current recession has obviously extended the era of "gadgets and gimmicks", but we seem to be reaching its end. It has been characterised by "Speak and Spell", "Space Invaders", programmable calculators and multi-purpose digital watches - the latest of which will translate 1,171 words from American (English) to Spanish and vice versa for the benefit of Puerto Ricans. Although essentially trivial and short-term, this phase could be responsible for massive shifts in public attitudes and an increasing public acceptance of information technology which has developed with accelerating rapidity and each generation has less and less time to recoup its research and development costs before its successor consigns it to obsolesence. The retail market is the obvious place to make profits sufficiently quickly and so whilst universities and factories lumber along with 1960s machines, pubs and living rooms are three generations ahead.

Whilst the first phase of development is associated with individual bits of technology, the second phase will see them linked together as systems. The development of e.f.t., electronic funds transfer, will straddle both phases. The components currently installed include cash dispensers and "point-of-sale" terminals. The latter will replace tills in supermarkets and read the machine-readable labels that appear on all groceries. They will total the customers' bill, adjust the shop's stock records and print a record of the transactions. When linked by land-lines to the shop chain's warehouse they will reorder stock and when linked to the customers bank's computers they will check credit worthiness and debit the appropriate account. For you, the public - or that part of the public considered credit worthy - the need to carry cash will continue to decline; for the banks, there will be the attraction of fewer unauthorised overdrafts and reduced staff and for large stores there will be fewer bad debts, automatic stock control and less staff. At present, only the inability of the telephone network to handle high quality, secure, data strands in the way of e.f.t., but soon fibre-optic trunk-lines will be introduced and the cashless society will arrive. Those disadvantaged by this revolution will include people who used to have jobs in banks or shops, those who own increasingly less viable small or family shops and people with no credit. Recent power failures in New York where "electric" or "plastic" money is already commonplace points to another annoying problem. People were exposed to the risk of starvation when the electricity failed.

OFFICE AND CLERICAL TECHNOLOGY

Another field that straddles the first and second phase is office and clerical technology. Here we have seen remarkable advances in the individual pieces of technology viz word-processors, designed to store, manipulate and reproduce chunks of written text, but we still await the development that will link machines together nationally and actually eliminate the need for paper.

So we are nearing Evans' second phase. This will be marked in hardware terms by robots, computers and databanks and chiefly by exponential growth - caused by the increasing ability of machines to design, build and programme more machines. Whilst robots are still a relative novelty in British industry (there are 1,152 compared with 3,500 USA robots) and computers in domestic situations are self-evident, the growth of databanks is less conspicuous. At present they exist largely separately, but interlinking and cross referencing is starting and as with e.f.t. will be promoted by fibre optic and improved telecommunications. Evans avoids the social aspects of this technology but current examples should not be dimissed lightly. A recent enquiry in France, into a government project to set up a terrorist file, discovered that the internal intelligence service already had 22 million names; Britain's MI5 is believed to have space for 20 million personal records; Scotland Yard has 1.3 million Londoners on file and a West German terrorist file has 3 million personal records. Recently details became public of computers installed at Heathrow Airport and linked to the Home Office automated data processing unit in Bootle. This will enable immigration officials to act immediately on information from the Home

Office, Foreign Office and MI5. By the end of the decade, machine readable passports will have made this sort of operation far simpler.

CHANGES IN LIFESTYLE

Evans concentrates not on these aspects, but on somewhat safer ones where the principal events will be the progressive decline of the professional classes, the death of the printed word, the electrification of money and crime and the transformation of work and employment. The book, newspaper and letter will be the first to go, along with anyone working on their production and distribution. They will gradually be replaced by word-processed and teletext networks such as Prestel. Costs will fall as fewer and fewer people are left manufacturing wholesaling and retailing the printed word and likewise correspondence will cost less as postal and secretarial staff is reduced. Home computers and word processors will be replaced by networks reaching into offices, homes and schools and improved fibre-optic trunk lines will transform what are currently limited passive technologies into responsive and interactive systems. Evans sees improvements in graphics and speech synthesisers leading to a fusion of cinema and literature, enabling the construction of personal dramatic fantasies as well as computer assisted learning based on dialogue and demonstration.

At the same time, doctors, lawyers, teachers and other specialist professions will also find their occupations changed. Computers will become "expert systems", the conversational reservoirs of knowledge that engage pupils and patients in a flexible responsive dialogue to meet their needs. This will leave teachers to counsel and advise, doctors to perform surgery and lawyers, while machines search out precedents and judgements, will be left with courtroom theatricals. The intellectual and cognitive content of their work will be systematised and preserved on computers enabling them to be used as active legal files and for medical diagnosis. Implications for teaching are most important. Here Evans sees computers assisting in the cultivation of a nation's assets, with good practice fostered and protected by governments, within this benevolent environment.

COMPUTER ASSISTED LEARNING

But for many people, computer-assisted learning is the most important application and here Evans sees, optimistically, governments and scientists dedicated to the careful nurturing of the nation's greatest asset, its people. He only grudgingly admits that pedogogical theories need to be a great deal better than they are today, if learning packages aren't to be infinitely worse that the teachers they replace. After giving a sample of a student of French engaged in a light-hearted banter with a computer, Evans moves on to money and crime.

MONEY AND CRIME

Here we see cash replaced by circuitry, homes safeguarded by sophisticated devices, motoring offences reduced by on board computers with criminals and police concentrating on computer-based fraud. Unfortunately, this era will also be marked by increased civil disturbances, as apparently the values of "religion, 19th century democracy, nationalist idealism, the inviolacy of the law and the immutability of social class" all collapse. Evans says no more, apart from predicting the rise of anti-computer activists in protest at the universal computerisation of every human activity.

The final section deals with work and robots and here Evans draws together some previous strands: the abolition of clerical work in the electronic office; the tendency for work to take place at home over teletext and data networks and so on. Then he goes more deeply into the coming of the robots, machines that combine the expected miniturisation and improvement in microprocessors with the latest in mechanical engineering. Whilst it is irrelevant whether or not they are humanoid, robots are beginning to replace people in repetitive, strenuous or dangerous physical tasks and as the reliability and responsiveness improve, this trend can only continue.

Whilst Evans' book is undoubtedly attractive and based on tenable extrapalations of current technology and trends, it sticks to technical areas and becomes journalistic as soon as it approaches social comment, so it seems fair to look at other sources for different perspectives.

"MICRO-ELECTRONICS AND SOCIETY"

"Micro-electronics and Society", a compilation by Trevor Jones, looks at technology from a social perspective and, with Christopher Evans, emphasizes that micro-electronics is an all persuasive technology and thus thinking in terms of local, discrete, trangible and often trivial pieces of hardware is all too sadly missing the point. There is now a convergence between three distinct technologies - computing, micro-electronics and telecommunications - and whilst progress will be erratic, the "new" technology they represent is maturing rapidly and is potentially equivalent in impact to the factory system or the internal combustion engine, with as many enabling and disabling aspects.

WORK AND CHANGES IN THE PATTERN OF EMPLOYMENT

Whilst none of the authors in the Jones' compilation make technical predictions that are noticeably different from Christopher Evans, the sort of context into which they are put is worlds away. They emphasize the chronic, and apparently structural unemployment in the U.K. economy, ever declining world trade position and the late and small scale involvement in high technology and remark that we may actually be undergoing "deindustrialisation" as our manufacturing base withers. In these circumstances, labour-intensive techniques are as much a threat to jobs as labour-saving ones. So the British economy is caught between the need to introduce new techniques to remain competitive and the desire not to add to an already mounting pool of unemployment. (In this context it may be worth mentioning that Clive Sinclair, of ZX81 fame, has created a business worth over £129 million but created only about 2,050 jobs).

Some of the papers look at the ways in which unions should be negotiating with companies to secure a socially worthwhile redeployment of their members but at present these negotiations have a relatively low priority.

MEN AND MACHINES

An examination of labour statistics suggests this may be misguided. A classic example is watches; from 1970 to 1977 the Swiss share of the market, based on clockwork, dropped from 44%to 29% and employment dropoped by 40% as Japanese and American manufacturers enlarged their share of the market with electronic watches. Meanwhile, the German timepiece industry shed 14,000 of its 32,000 jobs. Over roughly the same period, N.C.R. - who once had a large factory in Brighton - spent £169 million changing from mechanical technology to electronic devices and 19,000 employees out of the 37,000 total lost their jobs. In the U.K. the telephone supply industry workforce was reduced from 91,000 in 1971 to 56,800 in 1977 as new equipment was introduced. Over electronics as a whole, there has been a reduction in employment from 1969 to 1978 of between 10% for Olivetti to 40% for N.C.R. and production workers represent a decreasing proportion of employees; the same is true of the computer industry where, in the U.K. employment fell from 53,000 in 1971 to 43,000 in 1977. Both industries - electronics and computers - have nevertheless been enjoying an unprecedented boom in this period (the U.S. electronics market grew by 202% from 1963 to 1973 whilst U.S. per-capita g.n.p. grew by 70%).

Other industries will be similarly affected: robots are coming to automobile manufacturing e.g. Volvo installing 29 robots at a cost of £3.5 million to replace 70 men, Peugeot, Fiat, Volkswagen and British Leyland, and word-processors are coming to office work where the Central Policy Review Staff and a variety of consultants predict rises in productivity of well over 100%. At present in Europe, factory workers are supported by about 15-20 times more capital equipment than office workers. As office work becomes more technology-intensive, this disparity will change. Print is already undergoing these changes - ironically the weekly New Scientist with a great deal more ease than the Times - and in the U.K. banking employment declined by 50,000 between 1971 and 1976, though without conspicuously denting the declared profits of the clearing house banks. And so it goes on. More of these figures can be pursued in a variety of publications, including ILO's "The impact of micro-electronics" by J. Rada.

To return to the thrust of Jones' book, whilst unions need to give priority to understanding the extent of the forthcoming change in employment and taking whatever action is within their powers, there also needs to be a coherent lead from the centre, from central government. Unfortunately, the present decade has seen government committed to a reduction of direct intervention in the economy accompanied by a reduction in public sector employment, so central initiatives are likely to remain patchy and piecemeal.

It is unfortunately impossible to do justice to the quantity of data on the quality of research in Jones' book and many of the papers are impressive and important. There needs to be substantial public debate about the issues the book raises and adult education has a unique opportunity, not only to technically re-skill people, but also initiate a new dimension to social and political education.

The final paper picks up a rather optimistic thread. The advance of industrialisation has been marked by the dehumanisation of work as factories break down jobs into repetitive tasks. Computers and robots are beginning to replace humans in these activities so perhaps work will be "rehumanised". Unfortunately, this does not mean a benign transition to a "post-industrial" world.

CHANGES IN THE NATURE OF WORK

In future, then, society will need less and less physical and mental work from the population in order to service society's material needs. The effects of this change are difficult to predict. We could have full employment with a minimal working week for all or we could have widespread unemployment with job security for only a minority. We could have a redeployment of human resources into education and social services with an enormous expansion in the creative use of leisure or we could have millions leading wasted lives of enforced idleness. As computers and robots control more and more of the means of production, the ownership of these means of production will become concentrated in fewer and fewer hands, as will the expertise to control them. This may produce a polarised society, where science and technology have been used to dispossess most people. Alternatively, the state may take an increasing responsibility for the production and distribution of wealth to the benefit of all.

INFORMATION NETWORK

As the nature and value of work changes, so will the place and value of information. Computers and information networks will have a tremendous capacity to store, retrieve and transmit, information instantaneously. This could lead to the nightmare electronic police state feared by liberals and activists or it could lead to an open society where access to information and active participation created an electronic democracy. Or is may lead to the trivialisation of the political process, as computer-based referendums become a nightly parlour game.

The truth, no doubt will fall between all these wild-eyed extremes and educationalists will have achieved much if they can make a noticeable contribution to public debate about the future directions of society. But exactly what should this contribution be?

EDUCATION IN THE FUTURE

At present, many adult education professionals argue that our society, with its current rapid technical and cultural changes, needs a realistic commitment to continuing education. Initial schooling, even assuming everyone gets sufficient, cannot hope to prepare people for the world forty or fifty years after they leave school - this problem can only become more acute as the pace of computerisation accelerates. Furthermore, one hundred years of compulsory public schooling have failed to solve the "literacy problem" and indeed the way schools invest progressively more and more resources in pupils who "succeed" and less and less in those who "fail" could be argued to exacerbate the problem rather that cure it. Could not a schools-based computer education programme perpetuate a new sort of disadvantage and, in trying to produce "computer literates" also define others as "computer illiterates"?

Of course, conventional wisdom is slightly different and sees schools bearing the brunt of fitting people into the economy, whilst adult education on the margins, mops up recreational, remedial and retraining work (3 R's?). Whichever way one looks at it current initiatives seem patchy and unco-ordinated.

THE MICROPROCESSOR APPLICATION PROJECT (MAP)

In 1978, the Department of Industry set up the Microprocessor Applications Project to raise industry's awareness of microprocessor uses, training and consultancy. More recently, the same Department, with the MSC, has started setting up a network of information, technology centres to provide basic electronic and programming skills for YOPS trainees. They are modelled on the prototype Notting Dale ITEC and there should eventually be over 100 concentrated in economically depressed areas of the country. They are fairly hardware-intensive and the capital outlay is, in adult education terms, substantial, £100,000 per centre. Whilst centres are autonomous and thus one hopes responsive to local needs, the prototype's success depends to some extend on the wealth of opportunities and networks that London affords. A more worrying feature is the unbridged gap in the syllabus between hardware-based training (programming, electronic clerical work, etc) and the small liberal studies/social skills element that one feels should be filled with a more broadly based and transferable educational element.

Anyway, it is conspicuous that both these initiatives come from D of I rather than DES, whose contribution was the establishment in March 1980 of the Micro-electronics Developent Programme (MEP), backed by £8 million over 1981-84. So far it has been almost exclusively concerned with schools and associated teacher training, its principle objective being a computer in every school. Unfortunately, this aim is hampered by MEP's ability to offer only "matching" finance, round for round with L.E.A. (thus distorting the priorities of authorities already suffering cuts) or industry (in deep recession).

COMPUTER 'LITERACY'

The cataclysts for activity in adult education have been minimal - ITB's had made some funds available for courses, but the ITB's themselves no longer stand high in the government esteem. The BBC/NEC grand campaign for computer literacy was impressive as far as many of its components were concerned - certainly the books, the machines and broadcasts deserve high praise - but the overall effect was of a badly co-ordinated media and publishing event. It seemed to reach only an audience of enthusiasts; rather than create a climate of opinion and probably won't be the "On the Move" of information Technology, but then as a self financing exercise this has to be expected.

In the F.E. sector a variety of informal networks of software exchange have grown up and educational publishers have moved in. As their efforts and the spin-off from MEP, both grow out of schools, practitioners are back in the Ladybird books era of adult literacy. On the basic education front ALBSU is involved in several projects that use micro-computers (Bucks Numeracy Lift-Off, Bath Technical College) but is hampered in a number of respects. As a novel form of provision, evaluating and assessing proposals and projects will be difficult; secondly computer-assisted basic education needs a different pattern of expenditure (because of high capital costs and also the possibly enormous national economics of scale); thirdly it is not clear what part of information technology and computer literacy the unit should deal with (the situation resembles that of second-language work).

Finally the relationship between the voluntary sector (traditionally responsible for a high proportion of innovation in basic education) and the unit might founder as innovation becomes more capital-intensive.

CONCLUSION

To return to the general picture: in the short-term what is the way forward for basic education as information technology and micro-computers become more relevant? Principally there needs to be a recognition that computer technology is significant not only as a powerful teaching tool, but also a determinant of our social, economic and political future.

Numeracy, Publicity & Outreach

KEN MARKS

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In its discussion of the need to make effective contact with, and provision for, potential adult students the ACACE report *Continuing Education: From Policies to Practice*[1] isolates three different types of obstacle: "dispositional", "situational" and "institutional"[2]. The first is concerned with the attitudes and feeling of adults towards the idea of returning to study, the second with problems caused by personal circumstances and the third with the obstacles which we erect as educators.

Each raises important questions about the effective development of numeracy provision, but recent reports remind us of the special significance of dispositional barriers and make a useful starting point for discussion. Thus Brigid Sewell in her report *Use of Mathematics by Adults in Daily Life*[3] comments on adults who had had difficulties with mathematics at school and had either come to dislike the subject[4], or had developed a lasting "fear of mathematics" which they often attributed to specific experiences in the classroom[5].

THE COCKROFT REPORT

Nor is this a gloomy picture of the distant past. The Cockroft Report, *Mathematics Counts*[6], makes it clear that schools have continued to be dominated by an examination system which reinforces "feelings of inadequacy and failure"[7]. Taking the year blocks 1977-79 the authors note that almost all pupils were expected to study mathematics until they left school, but that one third received no form of qualification.

Perhaps worse: they also note that grade 4 C.S.E., the grade designed for the pupil "of average ability", equated with examination scores of some 30%. Grade 5, just below average ability, often required little more than 20%[8]. Gradings aimed at the average ability band can still be obtained from examinations set at such a level; "successful" candidates having failed to master more than two thirds of the content of set papers.

Some pupils would have been entered for a mode of C.S.E. with restricted grades (and would therefore achieve higher marks for each respective grade). However, even taking this into account, the figures reproduced by the Cockcroft Report still indicate that about one half of the 1977-79 grouping were all too likely to have completed the 5th year with negative feelings about the whole subject area*.

There is no necessary link between achievements - or the lack of them - in public mathematics examinations, and the ability to cope with functional numeracy. On the other hand the report also notes the vast divergence in levels of attainment for youngsters as they leave the primary stage.[10].

*55% of all pupils were either unqualified or received at best a grade 4 C.S.E result[9].

Clearly many eleven year olds enter the secondary school without the kind of grounding, and perhaps confidence, which would serve them best for mastering everyday tasks. Pressure from set syllabuses can then mask the importance of devoting sufficient time, and imaginative teaching, to this whole area. Nor is there likely to be any separation in the pupil's mind between functional topics and the broader mathematical mysteries which are encountered at this stage; mysteries which may well compound the whole attitudinal problem. A general feeling of inadequacy at school leaving age is hardly the best foundation for the practical maths of adult life.

MANY ADULTS DISLIKE MATHEMATICS

Returning to Sewell's commentary, she suggests that adults who had had problems at school, but had since learned to cope with aspects of functional numeracy, were far more likely to have had a straighforward dislike of the subject. Adults with lasting inhibitions pose a much more intractable challenge: Sewell even comments on symptoms of stress during some of the interview sessions[11], as well as a refusal to take part in the survey at all[12].

Although it would be misleading to think in terms of two simple categories, associated with dislike and fear, the distinction does suggest the need to consider two strands within a strategy aimed at providing for, and recruiting, potential students.

There must first be many adults whose problems stem from a healthy, if negative, response to school-based learning. Others again have simply forgotten what they once learned, or need to master new skills in response to changing personal needs. Many of these adults may well be able to make progress with little or no tutorial help. Should we be paying more attention to the development of resource centres offering advice about the use of a good selection of self-teaching material; including the availability of suitable video tapes, home-computer programmes, etc? Should we also, as local providers, be developing a more positive and active relationship with televised initiatives, as well as exploring other uses of the media?

It seems well worth asking these questions because, given the size of the challenge, it is necessary to be as cost effective as possible in the use of tutorial time. The immediate reaction of many practitioners is to be suspicious of anything which claims to encourage independent, or worse programmed, learning. Rightly so. The hierarchical nature of mathematics can be misleading. We have all experienced students who need to go two steps backward, and often one sideways, before they have the foundation to work from a stage they were convinced they had already mastered. We all know the

problems of moving some students forward through a veritable minefield of half-remembered, and mis-remembered, facts. Not for them the logical progression of an independent learning scheme.

On the other hand it could be that such experiences have led us to focus too much attention on the tutorial situation, to the detriment of attempts to explore the development and use of good self-teaching resources. It may be that, after an initial period of assessment, many students could progress without the level of tutor input which has become typical of current practice.

Apart from questioning the balance of our provision, the fact that there are adults who recognize a need to progress, and aren't thrown into a state of confusion by this need, raises another important issue: effective publicity.

PUBLICITY FOR NUMERACY PROVISION

One of the more disheartening experiences from the Sheffield Outreach Project, sponsored by ALBSU during the period 1981-83* was to realise just how few adults were aware that free numeracy provision was available throughout the city. This provision was an integral part of the adult education service, a service which has become increasingly decentralised in its provision over the past five years so that there is actually good availability. Most people were aware of local "evening classes" but still associated them almost exclusively with traditional activities like dress-making and car maintenance.

This in spite of a reasonable level of city wide publicity about basic education through local radio and newspapers, as well as the increrasing awareness of adult education provision. If experiences in Sheffield are any guide then publicity still presents a major challenge. However, it may be that part of the problem at least resides in a failure to present the right kind of message.

"BASIC EVERYDAY MATHEMATICS"

Another interesting insight which emerged during the course of the Sheffield project was that most adults knew what "Basic English" was likely to involve: reading, spelling, writing letters, etc. "Basic Everyday Maths" (or whatever alternative title we tried to use) proved more problematic. The most common reaction was an expectation that such classes would probably be about the four rules, and the arithmetic of money and percentage. Until prompted no one associated our offer of provision with topics like the understanding of everyday numerical data or mastering timetables and the 24 hour clock; one of the problem areas noted by Sewell and confirmed by the associated Gallup survey[13]. Some adults did not even immediately associate measurement, and the need for a working knowledge of units, with the titles we attempted to use.

It is interesting to note that the new national numeracy symbol, with its use of operational symbols, could actually make the problem worse! What seems to be important is that publicity be made specific. Whatever the heading or title, if one is needed at all, there should be a clear indication of what is on offer.

The Buckinghamshire Adult Numeracy Experimental Project seems to have come to similar conclusions and an interim report recommends "... plenty of examples like, 'We can help you to understand gas bills, tax... (and the) 24 hour clock.'"[14]. It also suggests some broader tags: "understanding ... your kids homework" and "Do you need to pass a TOPS test."[15]. Whatever the level and type of key phrases chosen for different situations the underlying message is the same. We need to communicate our wares by latching on to perceived and specific needs.

STYLES OF NUMERACY PROVISION

If one aspect of the problem is to get across the syllabus, another is to convey something of the style of numeracy provision. In the course of the Sheffield project we also met a significant number of people who had heard of various forms of basic education provision, if vaguely, but hadn't pursued opportunities because they assumed an unacceptable level of formality; "like going back to school".

One relatively easy way to begin to combat this is in the avoidance of educational jargon. Words like "class", "course", "term", "numeracy" and "creche", for example, often evoked adverse responses, if they were understood at all. It is necessary to find an alternative, and locally comprehensible, terminology. We also found it useful to introduce general phrases like "drop in and meet us" or "bring a friend"; phrases which gave some flavour of informality to our publicity.

Another set of factors which deserves careful consideration relate to the use of particular types of premises, and the way in which we organize provision. In the last analysis it is only possible to advertise what we have on offer.

It should be remembered that, if the challenge for literacy is to overcome embarrassment, then the equivalent challenge for numeracy may well be to overcome feelings of dislike and fear. If these were generated at school then the use of school (or college) buildings is likely to prove counterproductive. Once adults have passed the first hurdle, and made a fresh start with numeracy, attitudes will hopefully change; so that follow up work in educational premises does not necessarily pose the same problem. However, schools do not seem to make the best starting points.

PROVIDING ACCOMMODATION FOR NUMERACY TUITION

Clearly the use of educational buildings is tempting, at least to LEA organizers and administrators, in that it is free and relatively easy to arrange. On the other hand there are often a surprising number of alternatives available within the community. Over a two year period the Sheffield project was, for example, able to make use of a number of community centres, a health centre, a neighbourhood advice centre, a library, and even commercial premises like a pub and a Mecca bingo hall.

Many organizations, including those within the voluntary sector, have made use of alternative (i.e. non-school) accommodation over a period of years. However, where a service has developed a dependence on school-based facilities there is a good case for considering complementary alternatives for numeracy provision.

DROP-IN PROVISION

The style of organisation is also important. The "drop-in" approach, with its emphasis on being open to students at their convenience, but within set times, has much to

*The author was one of the two full time workers with this project.

commend it. The arrangement is parallel to the way in which adults experience many other services, and avoids creating the wrong kind of concern about punctuality and regular attendance; a concern which people often seem to associate with the language of classes and courses.

The approach is now well documented[16], but it is worth stressing that "drop-in" sessions *per se* don't have to involve substantial staffing and long opening hours. Clearly this is necessary where an initiative is aimed at providing a comprehensive service, if, for example, it is a city centre development. However, many local classes/groups work in ways which are actually very close to the "drop-in" rationale. Nobody minds if students have to come late, or leave early. New students do arrive at various intervals. People do miss sessions. Where this is the case there is much to be said for careful consideration of a restyling, both of provision and of publicity.

FLEXI STUDY

Another form of provision which deserves consideration is flexi-study. The NEC model, with its relatively heavy emphasis on correspondence material, probably offers the wrong balance at this level. However, the successful experience of the Northern Council for Further Education project, which set out to explore flexible learning opportunities in basic education, provides some useful pointers.

Correspondence material was certainly used, but normally only where it was the sole way in which contact with students could be maintained. The major effort was focused on other strands of flexi-study; the availability of learning resources, and tutorial sessions arranged by appointment to fit the needs of students[17]. Again the offer of teaching sessions by appointment has close parallels with other forms of service delivery which adults experience in everyday life. The approach also has the attraction of opening the way for tutors to encourage moves towards independent learning where this is felt to be appropriate for particular students (see above).

This variant of the flexi-study approach depends on the possibility of offering a variety of tutorial slots during the week. It also demands the availabililty of learning materials. Unlike the "drop-in", which suggests a general style as well as a distinctive type of organisation, it is perhaps best seen as an alternative, ideally a complementary alternative, to forms of localised provision which depend on short (typically two hour) sessions offered on a weekly basis.

This leads on to another aspect of organisation; the need to develop a coherent pattern of provision within a geographical area. The advantage of relatively large centralised units of the "drop-in"/flexi-study variety is that they allow flexibility. Indeed they may offer the only way in which some adults can take up systematic learning opportunities.

NEIGHBOURHOOD BASED PROVISION

At the same time there is a good case for developing a range of neighbourhood-based provision, both to alleviate problems with transport and as a foundation for outreach work.

The feature of outreach is the concern to make effective contact with people on *their* own ground. Although the right kind of publicity about the right kind of provision, obviously helps, it is unlikely to bridge the gap for adults whose reactions are typified by a fear of mathematics. As noted above a different kind of strategy is needed, and outreach initiatives offer some useful ideas.

First: there is the emphasis on going out to meet people in the community or workplace. The focus may be on contact with individuals: in the home (or on the doorstep), in the health centre, in a pub or shopping precinct, in the works canteen. It may equally be concerned with groups: mother and toddler groups or a less formal group in a factory or pub. What is important is the opportunity for dialogue, the chance to begin to at least sound out problems. What is equally, perhaps more, important is that potential students have the chance to meet someone, and that it is this individual, rather than the student, who is likely to be in alien surroundings.

Second: the concern is that this process should lead to, or link with, acceptable forms of provision in the community or workplace. Ideally if contacts are made in a particular place, then provision will be set up on the premises. If not other acceptable alternatives need to be explored. Whoever established the first contacts is normally responsible for setting up provision, or making arrangements to use existing opportunities, so that relationships can also be maintained at this crucial introductory stage.

'TASTER' INITIATIVES

It is important to note that there is scope here for short, fixed-term, "taster" initiatives. These can be less threatening to potential students, and, on the practical side, it is often easier to arrange to use of accommodation on this basis. Once adults gain sufficient confidence it becomes possible to consider referring individuals, groups of friends or even the whole group - provided, of course, there is a suitable and practical alternative.

This kind of approach does not of course offer a panacea. However, our experience in Sheffield suggests that, used sensitively, outreach is a useful way of beginning to break down barriers caused by feelings of inadequacy and fear.

Two factors proved to be important. First: it was easier to encourage people to think about taking up opportunities if the discussion took place in a relaxed atmosphere, and in the context of a formal, or informal group. Second: reticence could often be overcome by getting people to have a go at some basic maths; provided immediate support and reinforcement were available.

This reaction will not surprise tutors. It is similar to what happens in existing classes with students who have had to pluck up courage to seek help with numeracy, and whose whole attitude changes when they pass the hurdle of coming for the first time and actually doing some maths. What we were seeking to do was to encourage people to overcome this hurdle as part of a process aimed at recruitment. Our experience suggests that, used imaginatively, this tactic has considerable potential, and it may be useful to finish by describing two situations from the project.

NUMERACY FOR WOMEN'S GROUPS

The first was an attempt to attract students from a number of local women's groups in part of northern Sheffield. We set up our provision as part of a broader programme with keep fit offered in the morning, a short break for lunch, and our own basic maths (and English) in the early

afternoon. As we were using a pub it was also possible to arrange refreshments over lunch.

We publicised the sessions by visiting the groups, and as expected, keep fit was immediately popular. For our part we made sure that basic education tutors were on hand at the end of the first few keep fit sessions, as well as providing a range of materials for people to look at. We also encouraged the women to stop for a while to have a try at things, or to see what they remembered from schooldays; all in the relaxed atmosphere of a pub lunch-hour. The approach was so successful that within five weeks the maths/English sessions were more popular than the keep fit, and we found ourselves having to backtrack on recruitment with numbers soaring to twenty five.

The second initiative was aimed at two separate mother and toddler groups in a different part of Sheffield. Here we designed short parent-education courses to help adults find out about early schooling. The courses lasted five weeks and covered aspects of play and English, as well as maths.

The scheme proved popular, each group attracting up to 15 mothers. The courses were structured in such a way that participants had to try out samples of maths and English materials themselves; taking care to ensure a sufficient range, so that everyone could succeed with something. Again the approach proved successful and in each case led to the formation of a follow up group. One group wanted to brush up both maths and English, the other was just concerned with numeracy.

The pub group and the mother and toddler initiative each covered basic English as well as everyday maths. Our project normally set out to offer both as complementary aspects of basic education. However, for the purposes of this article, it is interesting to note that the value of the "have a go" approach was particularly marked with students who went on to work at numeracy skills.

CONCLUSION

In conclusion it is worth stressing that outreach should not be seen as a frill on a service which is already lacking resources. Nor should it be seen as a separate approach which can only take place within a special project.

In many areas the present pattern is perhaps too typical of most adult education provision with its relatively fixed classes and groups. Clearly any service needs a solid infrastructure. However it may be that a more fluid service, with tutors involved in a variety of forms of outreach, with short "taster" modules, and possibly with more emphasis on a movement towards independent learning, is actually a more effective response to the whole dispositional challenge.

Finally, it should be remembered that this article has focused on the "dispositional" dimension because of its particular relevance for numeracy. Although the general theme, recruitment, has caused the discussion to trespass on to institutional issues, there has been no attempt to take account of equally important situation factors. Some, such as the need to provide creches for mothers with young children, and the need to take account of problems with transport, have been mentioned in passing. However, any realistic attempt to plan and publicise effectively on a local, or broader area basis, must also depend on a careful consideration of the likely practical obstacles to be faced by potential students.

References

1. ACACE *Continuing Education: From Policies to Practice*, 1982
2. Op. cit. page 60
3. B. Sewell *Use of Mathematics by Adults in Daily Life*, ACACE, 1981
4. Op. cit. page 67
5. Op. cit. page 68
6. *Mathematics Counts*., HMSO, 1982
7. Op. cit. para 444
8. ibid
9. Op. cit. paras 189-195
10. Op. cit. Chapter 6
11. B. Sewell: op. cit. page 68
12. Op. cit. page 10
13. ACACE *Adults' Mathematical Ability and Performance*, 1982, pages 18 and 58
14. A Wilson: Interim report dated 30/7/82
15. ibid
16. A brief overview of two "drop-in" projects can be found in the ALBSU publication *Special Development Projects Report No. 3*, 1983
17. See, for example, the final reports submitted by the Open Door Flexistudy ALBSU Project. Available from ALBSU.

Who are these people with Numeracy Problems?

JOHN WILLIS

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THE NATIONAL CHILD DEVELOPMENT STUDY

Reading the Evidence from the National Child Development Study recently published by ALBSU is an interesting exercise in the use of numeracy. This is a study of people born in the week 3-9 March 1958, so the report can claim a reasonably random sample for its conclusions on education. "One in 20, or 5% of those interviewed reported problems with number work since leaving school," says the headline. Further down, we read that nevertheless, "four out of every five people who had had literacy problems had not had any problems with number work during the period covered by the survey. Thus we see that the majority of those with poor literacy skills are not lacking in numeracy skills."[1] Can this really be true? *Only* 1 in 20? Four out of every five peole with literacy problems had not had *any* problems with number work? The information in this study could clearly be effective in a campaign for more classes for adults: all we need to do is tighten up here and there, the problem is quite manageable, just reach those last 5% and we'll have a totally numerate society.

PERSONAL PROBLEMS WITH MATHEMATICS

I have problems with maths. I don't understand half the computerised bills I get, I find graphs and statistics presented on the television confusing, I'll make several trips to a shop to replace a spare part rather than measure it first - and I'm a tutor in basic maths. I know such feelings are widespread. All the time I hear "Oh, I'm hopless at maths" from people as "educated" as myself.

Which picture is true, mine or the study's?

First we should look at the sort of "number work" that the study is talking about. Let's make a few gueses:

> Checking change: adding or subtracting by counting/counting on. How much will something cost?: adding three prices together. Checking wage slips: adding and subtracting decimals on paper. Telling the time, reading bus numbers, writing down phone numbers.

If that's what the study *is* talking about, then it's feasable to me that only 1 in 20 should have these problems. But then the study goes on to say that:

> "27% of those who reported such problems since leaving school said these now caused everyday difficulties".

Only 27%. Our already meagre statistics are evaporating. The nation's maths problems are nearly solved. For we read further on that of the original 1 in 20, 25% have attended classes to improve their situation. As long as we carry on doing our jobs, it looks as though everything will be alright.

THE DEVELOPMENT STUDY'S STATISTICS

Or not, as the case may be. The interesting thing about this study's statistics is not what they tell us, but what they don't.

But what happened to the 73% of the 1 in 20 who miraculously *stopped* having problems with numbers by the time the survey took place? Surely it is unlikely that, having failed to understand *any* of the mathematics they were taught in the school for 11 years, they suddenly got the hang of it. More likely that, like the unknown quantity of respondents who had but wouldn't admit to having such problems, they devised their own strategies for coping with everyday demands. Perhaps they always bought £10 worth of petrol; always paid by cheque; always took far more money than needed when going shopping; relied on husbands, wives and children to check and pay bills, to measure or to read timetables.

Then what about the majority, probably of the population who *can* perform those few basic calculations; but *beyond* that have feelings of inadequacy, worry, helplessness with numbers. The study by ACACE[2] found such people in all five occupational groups, even science graduates who claimed to use no arithmetic, and others with academic qualifications who felt guilty at having such incompetence. This is what this paper is about.

So what are these numeracy needs that so many of us are lacking in? Why are we lacking? and what should we as adult educators be doing about it?

(a) Numeracy needs

The definition that the Collins Concise Dictionary gives to "numeracy", the ability to perform basic arithmetic problems, can clearly be a part of real numeracy. For example, my need to pass a TOPS Test is a very real numeracy need for me, whatever the arguments about the value of the test or the way it is used. But more important surely, for its general application, is to have a "feel" for numbers: to see that 5 times 95p is not far off £5, to recognise whether an answer on a calculator is right or is 10 times too much or too little, to have an idea of what 1 in 100 is rather than a formula for working out percentages, to guess that if it takes 10 minutes to walk half a mile it will take about 20 minutes to walk a mile. A 12% surcharge is not far off a 10%; £6,500 is halfway between £6,000 and £7,000; 4 feet is about so long, so this piece of wood is too short; this container will hold so many pints. Alongside this is the ability to tell *what* sum needs to be done. If my friend earns £1,000 a year more than me, what sum do I have to do to work out his salary? Or how do I work out the deficit from these sets of accounts? Much of this is to do with coping, surviving, having confidence in everyday dealings. These skills are not only applicable to personal matters, but to figures that we should be able to understand in society. In the ACACE study more than

half the population did not understand what inflation was; graphs and charts presented great problems. How many people understand how much a £50 cut in rates means the local authority must save? If one household produces 100 kilos of rubbish a week, what will the whole borough have to cope with? What effects a national growth rate of 2% is going to have on you or me? If a company spends £100,000 on advertising, what cost is passed on to the consumer? If I smoke 20 cigarettes a day how many in a year? If the government spends x billion pounds on nuclear weapons, how much each taxpayer contributes to all that? What it's like to earn £30,000 a year if you're only on £100 a week, or how many cleaning ladies equal one admiral? Why one factory makes a profit and another is uneconomic? Whether "x" Russian missiles against "y" American missiles actually means anything?

Of course most of this is political. But the state and large corporations and institutions dominate our lives more than ever, and the decisions they take nearly always have some mathematical justification. We need to be able to participate in the arguments, to use numbers to argue on our behalf in the same way as those in power often use to advance their own particular causes. In a society where the power of numbers is supreme and the need for numeracy all-pervading, most of us are more or less *in*numerate.

(b) Why can't we deal with them?

We're not innumerate because we're dumb or have problems of learning. People who come looking for maths classes are mostly quite normal intelligent people. But they (we) have gone through a school maths system which was quite inappropriate to real numeracy needs, and in many places still is inappropriate.

In the 1950s learning tables, sums and formulae by rote, followed by algebra, logarithms and the like, seemed to solve problems of classroom control but they were largely irrelevant to life as my generation saw it. Students in my present day adult maths classes seem to have been taught how to divide (say) once, but that knowledge has withered away through lack of application; while their secondary maths seems to have gone over their heads (as they kept them down at the back of the class).

So called modern maths was introduced in secondary schools in the sixties, in an attempt to teach understanding rather than rules, but it was successful mainly with top-stream pupils and served rather to confuse everyone else.

Pressure by parents and others has since combined the best of the new (e.g. graphs, statistics) with the old; but also heralded courses in "useful" maths for lower attaining pupils. Just when people were beginning to talk about numeracy, we got what was in effect a travesty of it - exercises on social security benefits, hire purchases, mortgages, budgeting - tedious in the extreme, irrelevant to most pupils but masquerading as "real life". Numeracy must surely be about giving confidence to tackle such problems in later life, but only by teaching skills in ways that pupils will feel them as "real", in activities which they can participate. Better courses (and partly better because they aim to teach numeracy across the whole ability range) have begun in recent years, with an emphasis on maths being fun, on the practical activities of measuring, drawing, making things, comparing and assessing results. But provision is patchy, depending on good teachers being in the right place with the right resources at the right time. There are still plenty of intelligent young people coming to adult maths classes knowing little, despite leaving school only a year or two ago.

Numeracy must surely be about giving confidence to tackle such problems in later life, but only by teaching skills in ways that pupils will feel them as "real" in activities in which they can participate.

A few adult maths students I have come across may well be from the "1 in 20" statistic in the NCD study quoted at the beginning of this article. They have problems with change, or the time, or the cost of two articles in a shop. (Though they won't admit this as a reason for coming to a class, rather they'll say they want to get on a training course or something). But most students, whether out of school two years or twenty, don't fit in any picture of the "1 in 20". They don't have problems with change etc. (maybe they shy away from checking supermarket bills, but who doesn't?) They don't ask for help with bills, or social security, or income tax. They dozed their way through much of school maths but now they see a point to it; maths is suddenly a means to "improving yourself", a means to further education or training. In some cases, the initial request to the tutor is to help the student pass an entrance test, not perhaps the best beginning to a new numeracy course. But by a strict definition, if we help him or her to do this, then we are teaching *some* numeracy. Can we do it in such a way as to pass on a more lasting confidence and ability with numbers actually making up for the school's failure?

(c) What should we be doing about it?

It is unfair to blame school maths *per se* for the numeracy problems that are widespread. The idea of maths as drudgery, a series of tests on learned rules, has been current for generations; today's children have to suffer their parent's attitudes as well as their teachers' The idea that you should buckle down and learn your four rules and fractions because you won't get a job otherwise, is still common. It's common even in the Manpower Services Commission, which still seems to believe that sums like $5\frac{1}{6} - 2\frac{1}{9}$ are actually used somewhere. (One recent survey of young people in work found that only 12% needed to do even the simplest fraction sum.[3] Another that even engineering craft apprentices don't need to know fractions other than the sequence, $\frac{1}{2}$ $\frac{1}{4}$ ... $\frac{1}{64}$ and their multiples).

Fortunately, most professional opinion has adopted a more progressive approach, notably in the Cockcroft Report on Mathematics in Schools.[4] And ideas for a more numeracy-based approach to the teaching of adults are now current, best put over in the John Traxler's and Bernard Gabony's Introduction to their "Working with Numbers: Ideas and Examples for Numeracy Worksheets".[5] I couldn't do better than seek their advice on "Maintaining Confidence" and their themes for group work: Length, Volume, Weight, Estimating and Approximating, Test techniques, Time, Speed, Area, Money, Calculators, Charts, Graphs, Statistics, Big Numbers, Schemes Finances and other practical maths - all based on familiar objects in the classroom.

A problem is that most groups fluctuate. Some people are here one week, gone the next; away on a casual job for a while, then back again; new people start each week, or old ones get places on a course. Yet something like estimating length is not something you can learn in a session - it needs constant reinforcement and discussion. I know I estimate lengths by the height of my body, or by knowing what an inch and a foot look like, or by saying "it's a hundred yards away" enough times for it to sink in.

We all learn in different ways, but most of us do at least need more than one worksheet to learn something of this nature.

One thing we need is to talk about what we're learning, and that's probably the most we, as tutors, can contribute in odd sessions. It can be difficult and wearing in a group where there are students pursuing different goals, and students sometimes don't like talking - it's not something you're supposed to do in maths. But it's a way of showing that there are different ways to a "right" answer, that you can understand more by discussing something than by the old fashioned "get on quietly with your work" school approach. And it's also a way of tutor and student working co-operatively, planning a programme of work as well as discussing how it's going. It's an essay in confidence more than manipulation.

CONCLUSION

To return to where we began, it has to be said that all this about "what we should be doing" can't just apply to tutors in adult numeracy classes. People who come to these classes are not the 1 in 20 of the NCD Study (though some of them may be), but the tip of a much larger iceberg. It is beginning to be recognised more widely that our society demands a type and a scale of numeracy quite different from the "problems with your shopping" approach. And that even though school maths is improving, there are millions of adults who deserve the chance of a reasonable numeracy course. Evening classes, classes to "help your child with schools maths" are a start. But, particularly for unemployed people, there is scope for most intensive longer-term, properly funded courses which students can be encouraged to follow right through. People with numeracy problems, just like those with literacy problems, are not mainly the slow, underprivileged few; they are the many normal adults like you and me.

References

1. Literacy and Numeracy: Evidence from the National Child Development Study (ALBSU 1983)

2. Adults Mathematical Ability and Performance (ACACE)

3. Survey "Maths in Work" by the London into Work Development Project , available from the ILEA Computing Centre, Bethwin Road, London SE5 0PR.

4. Evidence on the mathematical needs of employment to the Cockcroft Committee - Cockcroft Report "Mathematics Count" paragraphs 75 and 126.

5. Published by ALBSU. Introduction pages 5-7

Numeracy as a Communication and Coping Skill

ROS PENNY

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"When I use a word", Humpty Dumpty said in rather a scornful tone, "it means just what I choose it to mean - neither more nor less." "The question is," said Alice, "whether you *can* make words mean so many different things."

"Through the Looking-Glass"
by Lewis Carroll

DEFINITIONS OF NUMERACY

Gather ten Numercy Tutors together, ask them to define numeracy and you step instantly into Humpty Dumpty's looking glass world. Words such as "relevance", "basic maths", "every day arithmetic" and "coping skills" are frequently used with little agreement as to what they mean or what numeracy as a coping skill implies for both tutors and clients.

Numeracy is a relative new-comer to the nexus of "communication and coping skills without which people are impeded from applying or being considered for employment" (ALBSU 1982) and so has not yet received the same attention as literacy.

Examination of the literature reveals a spectrum of definitions of "numerate" ranging from "common-sense", (White, 1974) through "possessing numerical facility" to Crowther's (1959) use of the term as the "mirror image of literacy".

For competent, confident adults who have absorbed mathematical techniques and use them in daily life without recognising them as "Maths" (Sewell, 1978) being numerate must indeed appear synonymous with using common-sense. Regrettably, common-sense without a support structure of mathematical knowledge will not help someone calculate the cost of interest on a loan, estimate the quantity of grass seed required to create a new lawn or work out the best package deal for a family holiday in Benidorm.

Many would agree with Gabony and Traxler (1982) that "in practice numeracy is concerned with numbers (or more properly, quantity and relationship) which have a direct application to real life." But is this always so? For Gabony and Traxler say that "if mathematics represents the real world, then every part of arithmetic and numeracy must have a graphic, pictorial or real analogue to underpin it".

However, if numeracy is concerned with numbers, then arithmetic, (computation with numbers), is surely *part* of numeracy.

Additionally, although mathematics may be applied to concrete data, it is in itself abstract, and may be used to examine totally "unreal" postulates such as the behaviour of vectors in multi-dimenstional space or the square root of -1.

The power, and difficulty, of mathematics lie in its abstract nature and the fact that, unlike language, much of it is not used continuously in everyday life.

EVERYDAY ARITHMETIC

Certain aspects can be identified as Social or Everyday Arithmetic and Eddowes, (1983) writing about the mathematical education of girls, suggests that only arithmetic should be a compulsory school subject up to the age of sixteen.

Because many children never internalise mathematical concepts into a sound foundation and remain permanently confused she proposes that mathematics should be a separate option. This is intended to help girls who find mathematical problem-solving difficult and tend to drop out of mathematics and studies with a mathematical basis but who are now often required by their employers to demonstrate a higher level of numeracy than the job actually requires.

Such a line of reasoning implies that arithmetic equals numeracy and was evidently what the National Federation of Voluntary Literacy Schemes (1981) had in mind when they said that numeracy should not be a skill used infrequently to achieve some form of accuracy. For NFVLS numeracy forms the starting point for a number of diverse initiatives.

THE RELATIONSHIP BETWEEN NUMERACY AND ARITHMETIC

The relationship between arithmetical competence and numeracy is a frequently discussed theme. Cynics may see numeracy as easy Arithmetic by another name but a paper concerned with the construction of examinations "Differences between Numeracy and Arithmetic" (Royal Society of Arts 1980) identifies four major differences:

- context
- data
- techniques
- levels of complexity in the operation of the techniques

Furthermore, the authors observe that in real life the situations in which numeracy is required are relatively limited and they are specific to a particular individual.

In contrast "Arithmetic" problems are seen as contrived and unlikely to occur in real life. These problems normally contain only the data necessary to their solution, so students never need to develop the skill of selecting what is relevant.

Everyday life generally presents more than enough data from which a numerate person can extract all that is necessary to answer his/her needs.

Thus we see that Arithmetic is concerned with mechanical techniques, while numeracy requires judgement to draw inferences at an appropriate level from available data, calculate, approximate, estimate, use

calculators or other aids as suitable. As Glenn (1979) observed:

- "A good primary pupil will probably have learnt most of the necessary manipulative skills by the age of eleven and will gain in numeracy as he matures".

ADULT NUMERACY PROBLEMS

This gain in numeracy is neither automatic nor universal. Bridgid Sewell's (1982) work confirms that there is a substantial minority, possibly 14 million people, with numeracy problems and for whom the basic mechanical operations of arithmetic remain incomprehensible.

Some of these people also experience problems with literacy but many do not. Academic excellence or outstanding ability in other areas can still be accompanied by a "mental block" so far as mathematics is concerned. "Facts and figures terrify me to this day. I wasn't good at maths . . ." (Carla Lane, 1982).

Buxton (1981) describes at some length his work with intelligent articulate adults, most of them working in education, who experience feelings of panic in relation to maths. Again and again the words "panic" and "lack of confidence" re-appear in relation to the handling of mathematics needed in real life situations. This occurs even when the individual is capable of handling the necessary "pure" operations, and emphasises the difference between numeracy and arithmetic.

Risman (1977) found this lack of confidence to be the major problem because her clients had never understood the techniques they were attempting to use. These, blindly recalled, would be manipulated in a non-mathematical response to external details rather than as required in a given situation.

"MENTAL SKILLS PLUS UNDERSTANDING"

The necessity to understand what one is doing is echoed by Glenn, (1979) who defines numeracy as an integrated set of mental skills plus understanding. He lists fifty-six particular skills grouped under four main sections:

- operations with integers
- operations with decimals and fractions
- money and measurement
- other numerical concepts involving percentages, averages, estimation and approximation.

Most, but not all of these skills relate to the demands of everyday adult life.

Is it sufficient to construct some list of everyday mathematical knowledge and label this "numeracy"?

Cockcroft (1982) included among the mathematical needs of adult life the ability to

- read numbers and count
- tell the time
- pay for purchases and give change
- weigh and measure
- understand straightforward timetables, simple graphs and charts

and carry out any necessary calculations associated with these.

Obviously the list could be extended to include other needs such as percentages (mainly relevant to HP, discount, or borrowing money). It also does not mention certain mathematical skills which tend to be taken for granted. These are related to "ideal space" a body of images and ideas serving as the mental space in which an individual visualises him/herself as living and within which objects are situated and movement occurs. They are developmentally the first mathematical discoveries that a child makes (William and Shuard, 1976) preceding quantity and number. In particular, the adult mentally handicapped, brain damaged and dyslexic may have incompletely developed "ideal space". Acceptance of a check list of everyday mathematical skills as "numeracy" presents two problems. First, this would tend to the definition of numeracy as a limited and limiting coping skill and secondly, if numeracy is to be understood as a communication skill it must be seen in a wider context related to the potential self-development and employment of the individual concerned. Indeed, Cockcroft (1982) expected a numerate person to be able to cope with the mathematical demands of everyday life as well as understand and appreciate the ways in which mathematics may be used as a means of communication.

MATHEMATICS IS NOT A LANGUAGE

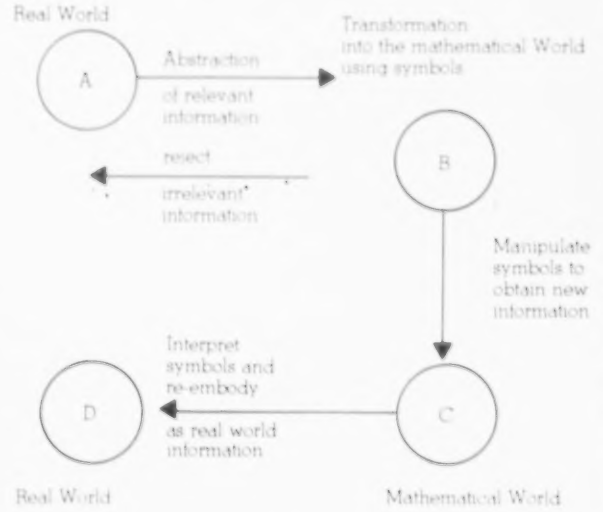
It is important to understand that one of the difficulties with mathematics is caused by the fact that it is not a language. As Molesworth (Williams and Searle, 1954) observed: "... if maths is a language I have only one comment. It is:

$$\sum_{0}^{\infty} \frac{b^{x}}{x!} \sum_{0}^{\infty} \frac{e^{m} M^{x} e^{tx}}{X!} = e^{-M} \sum_{0}^{\infty} \frac{(Me^{t})^{x}}{x!}$$

I think that settles the matter!"

Furthermore, although mathematics may be used as a means of communication, in practice its application is more complex. Symbols, evoking concepts may be used to communicate, record and investigate. These symbols can be verbal, evoking internalised speech, or visual, involving abstract ideas.

Skemp (1979) builds up a useful diagram representing what actually happens when a real-life problem is solved using mathematics.



SOLVING A PROBLEM

If the situation is sufficiently familiar then progress from A to D without the intervening stages is possible. For

example an experienced decorator can look at a room and without calculation judge the number of litre cans of paint necessary to cover the walls.

ARE LITERACY AND NUMERACY SIMILAR?

Finally, let us examine the Crowther definition of "numerate" as the mirror image of literate. The word was used in a section discussing the sixth form curriculum at a time when the sixth form was overwhelmingly academic.

Furthermore, the definition is later amplified making it certain that quite a sophisticated level of mathematical and scientific understanding is intended.

"On the one hand . . . an understanding of the scientific approach to the study of phenomena - observation, hypothesis, experiments, verification.

On the other hand . . . the need in the modern world to think quantitatively, to realise how far our problems are problems of degree even when they appear as problems of kind.

Statistical ignorance and statistical fallacies are quite as widespread and quite as dangerous as the logical fallacies which come under the heading of illiteracy".

This definition of numerate appears to survive in the description "a graduate from a numerate discipline" which appears fairly regularly in the Appointments pages of the quality press.

Such a view of numeracy would seem to be an unrealistic ideal which may well lie outside the range of many adults. Holt and Majoram (1973) described scientists and mathematicians as tending to think non-verbally, using visual or auditory mental images. Transmitting of such images has always been difficult. C.P. Snows "Two Cultures" and Hudson's "Contrary Imaginations" underline the mutual incomprehension of scientists and non-scientists.

Numeracy tutors may introduce scientific topics where this seems relevant to the needs of their clients, but not everyone would have the wish or ability to develop in this direction. We can draw a parallel with Literacy, where tutors sometimes read poetry with their clients but would not expect them to write sonnets.

Perhaps the key to a more useful definition of numeracy lies with Wertheimer's (1945) description of two modes of reasoning. The "A" response, nearest to the mathematicians way of thinking, elects behaviour determined by the requirements of the given situation. The "B" response, similar to behaviour described by Risman, is a reaction to the superficial details. A typical "B" response is the mindless recall of a drill and its attempted application even when inappropriate.

A DEFINITION OF NUMERACY

I feel that numeracy is best defined as "the ability to understand and use mathematics as a means of communication; to interpret a situation given in mathematical terms or to employ mathematics to represent a situation and if necessary use mathematical symbols to obtain further information."

Understanding and use must be linked to the needs of the particular individual.

For many, Cockcroft's list of the everyday mathematical requirements of adult life will be sufficient, while those whose interests, occupation or hobbies demand specialised mathematical skills require a broader mathematical base.

IMPLICATIONS FOR TUTORS

What are the implications for tutors in this definition of numeracy? The most important are:

- The individual's needs are paramount
- Techniques for analysing problems need to be taught
- Understanding abstract mathematical concepts matters.

These three ideas have strongly influenced the Numeracy Lift-Off Project in Merseyside and Cheshire where seven working groups of numeracy practitioners have been funded by ALBSU:

- to provide a focus for curriculum and materials development
- to disseminate information and materials to providers and potential providers
- to encourage evaluation of materials
- to promote numeracy training

The working groups concentrated on the following areas of concern:

1 Very Basic Materials for Slow Learners and Absolute Beginners

2 Assessment Processes and Materials

3 The Use of Microcomputers in Numeracy Provision

4 Particular Needs of the 16-19 Age Group with Special Reference to the Youth Opportunities Program

5 Training in Numeracy Provision

6 Special Needs: Budgeting and Measurement

7 Good Practice in Numeracy Provision.

The resulting materials were circulated through a series of project Newsletters. Let us examine the relationship between the philosophy and the practice.

The individual's needs are paramount

Both the "Assessment" and "Training" working groups see initial assessment as a two-way process between equals in which tutor and client establish what is required. It may not be appropriate to complete assessment and diagnosis in one session but the establishment of a starting point is essential.

To emphasise that the relationship of tutor and client is not that of teacher/pupil as experienced during failure at school, the idea of a "contract" has been developed. It lists topics in which the client already feels competent, and those he/she wishes to learn. It is prepared during discussion, informal testing and counselling sessions which should be confidential. Possession of the "contract" means that the client sees him/herself as being in control of learning rather than being directed to what is "good for him/her".

The initial assessment procedure includes:

- Motivation
- Literacy assessment
- Perceptual difficulties
- Language assessment
- Hand-eye co-ordination and spatial concepts
- Discussion of feelings about learning
- An initial maths diagnosis to estalish a starting point.

It is not desirable that prospective clients should be subjected to an intensive testing session. Many adults have experienced failure with tests and tutors should not needlessly continue this pattern. Much information can be obtained by the tutor attentively listening and observing.

For example:

Does he/she have problems reading the numeracy materials used? If so, are they related to literacy level, vision, hearing, confidence, understanding or perception?

Is an incorrect answer to a mathematical problem due to:

- fears
- lack of confidence
- difficulty with any reading required
- physical handicap
- inability to analyse the problem and identify which mathematical operations are necessary
- not understanding the mathematical concepts
- inability to perform the required mathematical manipulations
- making errors in the calculations
- poor hand/eye co-ordination so correct answer is written incorrectly
- a mistake in writing the answer?

As the work of the Assessment of Performance Unit (Foxman, 1982) has amply demonstrated, transferring a mathematical problem from visual to verbal to contextual multiplies the incidence of error by up to twelve times. This aspect of numeracy is examined at greater length in the section on the analysis of problems.

Concern for the needs of the individual has led to the development of the Exam Pack enabling tutors whose clients wish to take exams to make a more informed choice. The Pack lists and compares the most commonly used certificated and non-certificated exams or tests relevant to the North West area. Thus the "O" level exams included are those of the Joint Matriculation Board based in Manchester.

THE SPECIFIC PROBLEM OF THE 16-19 YEARS GROUP

The sixteen to nineteen age group in Youth Training Schemes presents special problems for the tutor among which the lack of motivation dominates.

Motivation can be improved in many ways including:

- establishing the relevance of numeracy
- providing interesting materials

The "16-19" group Practical Diagnostic Test was a series of 15 activities involving everyday numeracy skills set out around a room. It was intended to give objective information about a client without appearing to be a formal test. The activities were of particular interest to that age group such as using a timer with a second hand to find how long the latest "top of the pops" takes to play, using a calculator, and relating a darts board to questions on fractions.

Fun, interest and relevance combine in ACE and SPEND, the two situation games devised by the "16-19" group.

ACE is a monopoly type of game in which up to eight players experience everyday life situations.

Players buy and sell the types of goods coveted by this age group - leather jackets, space invader games, racing bikes, Hi-fi equipment, LP's, jeans.

"Good" and "Bad" chance cards can lead to familiar dramas such as forgetting to sign on at the Social Security Office, getting mugged, losing the front door key, winning a disco competition, getting a pay rise, or receiving a birthday present from all the other players.

In use with a group of vocational preparation trainees from special schools, the game has led to an actual understanding of the concept of budgeting. A group that had not previously realised that if a large amount of money was spent in a particular way then little or nothing would be left for other purposes, now discussed different options before receiving their weekly allowances.

SPEND is a large format game for any number of players related to the spending of money in six situations:

- social club
- amusement arcade
- shop
- garage
- betting shop
- canteen

Sensitivity to individual needs is reflected by:

- the blank spaces for prices and amounts on display sheets so tutors can keep up-to-date or modify the game for particular groups
- no detailed rules so the game may be played as decided by the group involved
- it is suggested that if other situations are preferred, they may be prepared along the same lines

Experience with this game in use has confirmed the validity of this flexible approach allowing tailoring to particular needs. Many tutors have reported enthusiastic discussion and development, not only in numeracy, generated by SPEND.

Difficulty encountered with mathematics in context has already been mentioned. The Special Needs; Budgeting and Measuring Group developed a series of four resource packs related to everyday life and certain employment or training needs. These all gave practice with use of mathematics in context as follows:

- Measurement at a fairly simple level for those wishing to work in science, technology, engineering, manufacturing, and construction industry
- Money problems of everyday life
- Time, timetables and travel
- Basic everyday measurement related to the Home and Self.

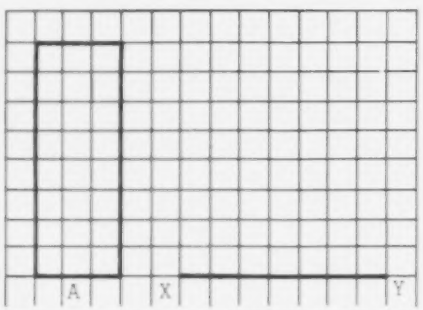
Techniques for analysis of problems need to be taught

Although it is dangerous to generalise on the basis of investigations into children's mathematical performance, some of the Assessment of Performance Unit's work related to fifteen year old's does seem to offer useful insights for adult numeracy tutors. Our experience appears to confirm the finding of the APU that whether the majority gets an answer right or wrong can depend as much on the way the question is asked as the maths involved.

Foxman (1982) describes how:

"In the 1980 secondary survey, three different samples of 15-year-old pupils were asked the same question presented in slightly different ways. They were asked about the dimensions of a rectangle which had one side 6 units long and was the same area as another measuring 8 units by 3 units. The three presentations were visual, verbal and a situation in which area was simply implied by the context of seeding two lawns with equal amounts of grass seed. As shown in the diagram below, the incidence of the error of preserving the perimeter instead of the area was 2 per cent in the visual presentation, rose to 11 per cent in response to the verbal item and then to 24 per cent in the contextual item. The corresponding percentages of correct answers were 76, 60 and 51 respectively. These results demonstrate that about a quarter of 15-year-old pupils have difficulty with the basic ideas of area and perimeter, and that a further 25 per cent at least are uncertain about the appropriate application of these concepts in some situations."

Using the line XY as base, draw a rectangle which has the same area as shape A.



answers	6 x 4*	6 x 5	Same rect. but diff. orient.	Other	Omitted
%	76	2	5	14	3

A rectangle has a length 8m and width 3m. Another rectangle of the same area is drawn with length 6m. What is its width?

answers	4*	5	3	Other	Omitted
%	60	11	2	22	5

A gardener has enough grass-seed to seed a lawn 8m by 3m. If, instead, he uses it to seed a lawn 6m long, how wide will it be?

Response	4*	5	3	Other	Omitted
%	51	24	1	16	8

Correct answer

Foxman concludes that it is important for teachers to know how their pupils perceive a problem and what methods they use to tackle it. The extent of an individual's understanding of particular concepts and skills is not revealed by a limited range of examples. Pupils need to meet ideas in a variety of mathematical and everyday contexts to gain experience of applying them appropriately.

Many of the real life problems adults face are not highly structural with one correct answer. Helping out clients to cope can be approached from two directions:

- giving practice in problem solving and decision making
- giving practice in the particular numeracy contexts required by that client.

Sometimes a client brings a major real life problem involving decision making to their tutor. Analysis and investigation on the lines of the De Bono (1977) "consider all factors" model can be beneficial to everyone especially if the client is willing to allow a group to work with him/her.

GENERAL PROBLEM SOLVING

A fruitful source of ideas for general problem solving and decision making can be found in De Bono's work on Creativity (De Bono, 1970). Aiding clients to consider all the factors that could be involved in a particular decision forms a major step towards the identification of relevant data from irrelevant "noise" and the evaluation of outcomes consequent upon various courses of action. The Special Needs: Budgeting and Measurement Group emphasised that any work involving sensitive issues like personal finance, should be presented as a way of looking at choices rather than suggesting that there is one "right" method to organise spending.

The testing of numeracy skills in context is a relatively new phenomenon. The Assessment of Performance Unit (Foxman, 1982) has suggested that practical maths tests are sufficiently well developed to be included in public examinations. The interest and difficulties revealed by the "16-19" working Group's practical diagnostic test emphasises the need for the development of more secondary school level materials related to everyday applications.

THE PRACTICE OF NUMERACY SKILL IN CONTEXT

Practice of numeracy skills in context is a well established feature of adult numeracy teaching. Worksheets based on the various types of problems likely to be encountered in adult life such as shopping, DIY, dressmaking and similar situations can be presented in a structured way. Many materials developed by the Special Needs Group: Budgeting and Measurement fell into this category.

Belief in the importance of contextual materials is such that in their "Begin Here" Pack the "Slow Learners" Group introduced money handling, shopping and time at a level suitable for the adult mentally handicapped.

USE OF GAMES

An even closer approach to the real life situation is offered by the use of games and certain open-ended activities. Here the questions may have to be formulated by the clients and exist as a series of decision-related options.

The situation games, ACE and SPEND, are obvious examples but tutors can move nearer to real life through role play. In a familiar, secure environment the terrors evoked by the prospect of checking change, opening a bank account or claiming social security benefits can be examined, discussed and minimised by rehearsing that particular event.

Understanding Mathematical Concepts Matters

We are all familiar with the client who asks to be shown how to "do" division of fractions and whose attitude says "Don't bother me with why, just show me how."

For many, mathematics represents a series of difficult random facts linked to calculation performed at speed and comprehensible only to possessors of giant intellect and incredible memory. These two statements may

appear unrelated but the link lies within the understanding of mathematical concepts.

THE IMPORTANCE OF MATHEMATICAL CONCEPT

But what do we mean by this term "concept"? Essentially it is an idea based upon the classification of many experiences. Thus concept "two" is established after encountering two chairs, two mugs, two plates and having these named to assist in the classification process. We must also distinguish between primary concepts derived from our direct sensory experience of the world and higher order concepts abstracted from them.

Experience with many blue objects leads to the primary concept "blue". Adding to this "red", "green", and so on leads to the establishment of the second order concept "colour".

Linkage between concepts leads to the formation of mental structures known as schemata which integrate existing knowledge and form a mental tool for the acquisition of new knowledge.

So we see that if mathematics is presented as a series of items and drills these will not be recalled unless practised constantly because there is no apparent link to make them meaningful. Emphasis on mechanical skills in preference to understanding leads to an inability to define a problem in context. Thus a client may be able to work out the area of a rectangle but not understand how this relates to the quantity of tiles that should be bought to make a splash back for the wash basin at home.

"SOCIAL OR SURVIVAL" MATHEMATICS

"Social" or "survival" maths has the intention of helping people cope with the numeracy problems of everyday life through practising activities such as giving change, working out the cost of decorating a room and understanding timetables. Though these are useful activities and can be directly related to the demands of a particular client's daily life, if not supported by an understanding of the mathematical concepts involved, they will form yet more mechanical drills likely to be mis-remembered and apparently *applicable only in the circumstances to which they belong*. The possession of an integrated conceptual structure means that it exists permanently as a tool to use in problem solving without placing a great burden upon the memory.

LEARNING MATHEMATICAL CONCEPTS

The learning of mathematical concepts, their organisation into schemata, modification and expansion is examined in some detail by Skemp (1979). His work and that of Piaget (1952) confirms the view that the best teaching method is experiential, that is through the provision of suitable guided learning experience. Mathematics cannot be learned directly from the environment but only indirectly through other mathematicians because it is based up a hierarchy of abstract and generalised concepts abstracted or generalised from earlier lower order concepts.

This means that the learner can rapidly acquire ideas that took centuries to develop. It also makes him/her largely dependant upon the tutor and the teaching materials provided. It is for this reason that the use of volunteers and the involvement of clients in mutual help teaching needs to be carefully supervised.

The building up of a structure of successive abstractions may be compared to building a wall. If, in the rush to finish quickly, the foundations (low order concepts) are skimped the wall will collapse once a certain height is reached. Rate of learning may appear faster and requires less effort in the initial stages but is unsatisfactory in the long term as confirmed by Skemp's (1979) figures.

An essential part in mathematics is played by the symbol which is the sound or visible mark attached to a particular concept. These are two different things and their distinction is not trivial. For if an object is called by another name this does not change the object (concept). The Slow Learners' Group tried to put across the idea that the same operation may be given different names. For example the symbol ÷ can be regarded as "divide", "share" or "how many times does — fit into —?"

Understanding the concepts fundamental to mathematics is crucial in the development of numeracy. For this reason several games reinforcing basic number concepts and place value were devised by the Slow Learners' and Special Needs, Budgeting and Measurement Groups. Games have the advantage of providing a great deal of enjoyable practice in a short time and can, if suitably designed, test understanding more rigorously than many worksheets.

We tried with the aid of our graphic designer to produce materials with a minimum of distracting detail so the abstract concepts were clearly communicated. This policy was followed by the "Microcomputer" group whose "Decimals" program depended upon animated graphics for its impact.

> "We believe it is important to have the feeling for number which permits sensible estimation and approximation - of the kind, for instance, which makes it possible to realise that the cost of 3 items at 95p each will be a little less than £3 - and which enables straightforward mental calculation to be accomplished"
>
> *(Cockroft 1982)*

CONCLUSION

This feeling for number depends upon conceptual understanding used in conjunction with judgement. It is not a simple skill to be acquired mechanically since there must be discrimination between situations such as doing the weekend shopping, where absolute accuracy is not essential and those, like the calculation by a nurse of a child's dose of pencillin, where it is. Worksheets using techniques similar to the APU's Guess and Test, were developed by the Special Needs, Budgeting and Measurement Group. These asked the client to forecast the result of an activity which could be a measurement, a calculation, or the time a journey might take. This was followed by accurate measurement or calculation so comparison of the results provided feedback to improve the next attempt.

Finally, it would be foolish to pretend that mechanical skills do not require practice. Tutors involved in Lift-Off acknowledged this by developing materials such as the "Sumfinders" and "Match the Pairs" of the Slow Learners' Group.

However, as I hope I have already established, a set of mechanical skills used without understanding cannot be described as a communication or coping skill and is unworthy of being called Numeracy.

Bibliography

ALBSU (1982) Newsletter No. 10, P1

BUXTON, L. (1981) "Do you panic about maths" *Pub Heinemann*

COCKROFT, W.H. (1982) "Mathematics Counts" *Pub HMSO*

CROWTHER, G. (1959) A Report on the Central Advisory Council for Education (England) *Pub HMSO*

DE BONO, E. (1977) "Lateral Thinking: a text book of Creativity" *Pub Penguin Books*

EDDOWES, M. "Humble Pi: The Mathematics Education of Girls" *Pub Longman Resources Unit*

FOXMAN, D. (1982) "Testing, testing, - one, two, three . . . . " *Times Educational Supplement, 10 December, p18-19*

GABONY, B. and TRAXLER, J. (1982) "Working with Numbers - Ideas and Examples for Numeracy Worksheets" *ALBSU and Friends' Centre*

GLENN, J.A. Ed. (1978) "The Third R: Towards a Numerate Society" *Pub Harper and Row*

HOLT, M. and MARJORAM, D. (1973) "Mathematics in a Changing World" *Pub Heinemann*

HUDSON, L. (1968) "Contrary Imagination" *Pub Methuen*

LANE, Carla (1982) Sunday Express, 14th November

NFVLS Report of a Workshop held 30-31st October 1981

NUMERACY LIFT-OFF PROJECT Jan 1982 - July 1983

PIAGET, J. (1952) "The Child's Conception of Number" *Pub Routledge and Kegan Paul*

RISMAN, A. (1977) Adult Numeracy Project in Reading, Berkshire. *An internal report*

SEWELL, B. (1978) "Maths in Everyday Life" *Reading Adult Education Service Report*

SEWELL, B. (1982) "Adults Mathematical Ability and Performance *Pub ACACE*

SHORTER OXFORD ENGLISH DICTIONARY (1967) *Pub OUP*

SKEMP, R. (1979) "The Psychology of Learning Mathematics" *Pub Penguin Books*

SNOW, C.P. (1959) "Two cultures and the Scientific Revolution" *Pub Cambridge University Press*

WETHERIMER, M. (1945) "Productive Thinking" *Pub Harper & Broster*

WHITE, D. (1974) "Unnumbered Problems" *Pub New Society "May 30th 1974*

WILLIAMS, E.M. & SCHUARD H. (1976) "Primary Maths Today" *Pub Longman*

WILLIAMS, G. & SEARLE, R. (1954) "How to be Top" *Pub Max Parrish*

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